The Unesco Courier

OCTOBER 1980 - 3.50 FRENCH FRANCS

Avicenna

TREASURES OF WORLD ART

156

USSR

Ceramic art from Samarkand

A woman's features are traced in a few simple lines on this fragment of a glazed ceramic dish, a product of the culture which flourished in Central Asia under the Samanid dynasty in the late ninth and tenth centuries. Unearthed at Afrasiyab near Samarkand, the piece is one of many discovered since the beginning of the century which reveal the brilliant development of decorated earthenware art in this region during the age of Avicenna.

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A window open on the world

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Cover

Illustration from a 17th-century Persian manuscript shows Avicenna (Ibn Sina) taking a patient's pulse. The Arabic inscription beneath it is a reproduction of a notation in Avicenna's own hand on the cover page of an Arabic translation of "The book of the excellent Galen *On Medical Sects for Students*". The notation reads: "[Came] into the possession of Husayn Ibn Abd-Allah Ibn Sina the physician in the year 407". The year 407 of the Hegira is the equivalent of the year 1016-1017 in the Christian calendar.

Photo by courtesy of the Wellcome Trustees, London

The year 370 of the Hegira, exactly one thousand years ago according to the Christian calendar, marks the birth of Ibn Sina, one of the most famous and most influential of the philosopher-scientists of Islam.

Ibn Sina, or Avicenna as he is better known in the Western world, was born near Bukhara, in Central Asia, in a region which then formed part of the Abbasid caliphate. But this immense community, stretching from present-day Afghanistan in the east to southern Spain in the west under the banner of Islam, was disintegrating politically. Independent local dynasties were arising which admitted only nominal allegiance to the Caliph in Baghdad.

Far from heralding a parallel cultural decline, however, this break up was to usher in a golden age of Islamic civilization. Each of the emergent new States made their own scientific and cultural contributions and their rulers vied with each other to attract to their courts the greatest minds of the period. Spreading to the West, the rich outpourings of this resurgence were to act as a leaven of the later European Renaissance.

Avicenna was a key figure in this cultural ferment. Permeating the whole of Islam, his influence penetrated Europe through Muslim Spain where it remained a force for centuries. Standing at a crossroad of history, where different civilizations and epochs met, Avicenna was a figure whose genius is the inheritance of all mankind. This issue of the Unesco Courier *is devoted to an examination of the many facets of this remarkable man.*

Photo Unesco

Avicenna - Ibn Sina
A universal genius

by Muhamed S. Asimov

"AL-SHAYK al-Ra'is" (prince among scholars) —such was the title bestowed in the Orient on Abu Ali al-Husayn Ibn Abd-Allah Ibn Hassan Ibn Ali Ibn Sina, traditionally known in the West as Avicenna.

He is one of the most extraordinary figures in world history. A philosopher of encyclopaedic knowledge, scientist and experimenter, eminent theorist of medicine as well as clinician and healer, poet and musician, he was also a Grand Vizier (prime minister), then a chain-fettered prisoner, an indefatigable traveller who visited many regions of central Asia and Persia, and the author of a vast corpus of writings covering almost every branch of contemporary knowledge.

This great thinker was also a man whose human qualities of integrity and nobility of character gave rise to a host of legends some of which are still told today. According to one of these stories, little Husayn's mother was bathing him in a bowl when she unwittingly dropped a gold ring into the bathwater and then threw it away. When she noticed that the ring had gone, she accused a servant of responsibility for its disappearance and severely punished her. Thereupon, young Husayn, wishing to rectify this injustice, spoke up and said: "Mother, beg the servant's pardon for it was not she who lost the ring". These are said to have been Avicenna's first words.

Born in 980 AD (370 of the Hegira) to Abd-Allah, an official at Balkh (in the northern part of present-day Afghanistan) and to Sitora, the daughter of a farmer from the village of Afshana near Bukhara, Avicenna revealed his exceptional qualities very early in life. By the age of ten he had already completed the usual school curriculum and could recite all the Koran by heart. At sixteen he was a physician whose renown was such that he was summoned to treat the Emir of Bukhara himself. By curing the Emir the young doctor unlocked for himself the doors of the Emir's celebrated library, the "Sanctuary of Wisdom".

"By eighteen or nineteen," Avicenna later told his disciple and biographer Juzjani, "I had already made myself familiar with the whole of philosophical knowledge—logic, physics, mathematics, geometry, arithmetic, astronomy, music, medicine and many other disciplines—so that I met no one who was my master".

This was no exaggeration. His memory, and the range and depth of his knowledge were stupendous. When the library of Bukhara burned down, people consoled themselves by saying: "The Sanctuary of Wisdom has not perished. It has been transferred into the brain of Al-Shayk al-Ra'is!"

Avicenna's relatively brief life (he died aged fifty-seven) could be epitomized as one of titanic creation. He worked at all times and in all conditions. He wrote or dictated his works day and night, in prison or on his travels, even on horseback. The Iranian scholar Said Nafissi calculated that he wrote (or had attributed to him) 456 works in Arabic and 23 in Persian. At least 160 books by Avicenna are listed in the catalogues of the world's libraries.

Photo © Jean-Loup Charmet, Paris. Museum of the History of Medicine, Paris

Photos taken from *Le Livre du Millénaire d'Avicenne*, Teheran, 1953

Photo © Ibn Sina Institute of Medicine, Tadzhik SSR. Painting by M. Khoshmuhammedov

Photo © Jean-Loup Charmet, Paris. Philadelphia Museum of Arts

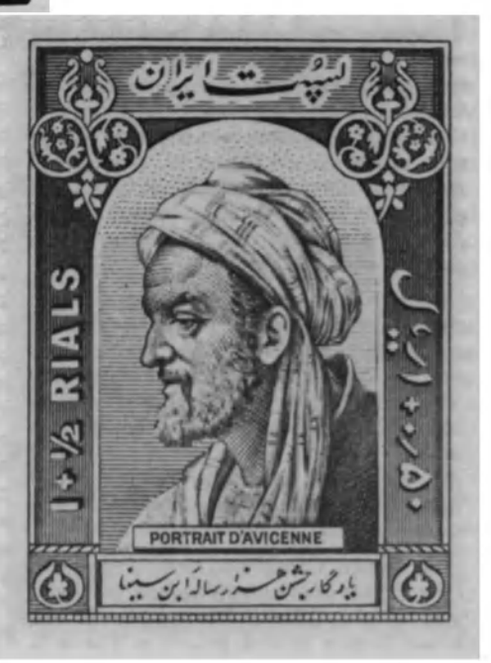


Photo © Iranian Delegation to Unesco

Shown here is a small selection from the imaginary portraits of Avicenna produced by artists of many countries in the last ten centuries. Clockwise from top left: a study by an anonymous artist which was reproduced many times in European editions of Avicenna's work; fragment from a stained glass window; head discovered in 1950 beneath a layer of plaster on the wall of the Bodleian Library, Oxford; commemorative stamp issued by Iran thirty years ago on the thousandth anniversary of Avicenna's birth according to the lunar calendar; detail from title page of a 16th-century medical work published in Strasbourg; portrait executed in the 1950s by an artist of the Tadzhik SSR. Opposite page: a medal just issued by Unesco to mark the thousandth anniversary of Avicenna's birth in the Christian calendar (for details see page 46).

A medieval engraving depicts Avicenna seated on a throne, a laurel crown on his head. Galen and Hippocrates are shown at each side of him. If Galen and Hippocrates were the fathers of medicine, the unknown artist seems to be saying, Avicenna was its prince and its hero.

This symbolic representation of Avicenna's qualities is fully justified, for in the Middle Ages the words *Avicenna* and *medicine* were virtually synonymous. His great work the *Canon of Medicine* is a remarkable synthesis of medical knowledge, which presents the achievements of the most outstanding Greek, Indian, Iranian and Arab physicians. The author's range, the logical rigour of his thought, the conciseness and lucidity of his exposition, his novel approach to the eternal problems of medicine as well as to the formulation and solution of new questions, the freshness and originality of his thought—all these factors make the *Canon* a work without parallel (see article page 13).

Translated into Latin in the twelfth century by Gerard of Cremona, it became for centuries a veritable Bible of medicine. (In fact, after the invention of printing with movable type, it became the second most widely printed book after the Bible.) In the *Canon* Avicenna not only produced a brilliant synthesis of his predecessors' work, he greatly enriched medical science through his own observations and discoveries.

MUHAMED S. ASIMOV, *of the USSR, is President of the International Association for the Study of the Cultures of Central Asia, a corresponding member of the Academy of Sciences of the USSR, and President of the Academy of Sciences of the Tadzhik Soviet Socialist Republic.*

He was the first person to describe correctly the anatomy of human eye muscles, and devised an explanation for the mechanism of sight which is not far removed from the modern conception of this phenomenon. He explained with precision the heart's system of ventricles and valves. He described smallpox and measles, illnesses unknown to the physicians of Ancient Greece. His analysis of diabetes does not differ greatly from that made eight centuries later by the English specialist Thomas Willis.

He put forward the hypothesis that certain infectious diseases are transmitted by "tiny organisms" in water and in the atmosphere, and in the eighteenth century this hypothesis was confirmed by the Dutch scientist Antonie van Leeuwenhoek (1632-1723) in research using microscopes he had constructed himself (see *Unesco Courier,* June 1977). His observations on the pulse are of very great interest (he counted sixty simple and thirty complex variants), and modern science has added few refinements to his work.

He invented a number of diagnostic procedures. The percussion method, for example, whereby internal sicknesses are located by tapping the patient's body with the finger, is associated with Avicenna, although it was later rediscovered by the Viennese physician Leopold Auenbrugger (1722-1809). However, the essential importance of the *Canon* lies in the principle of "natural causality" on which it is based and from which Avicenna drew inspiration not only in the field of medicine but in all his scientific work.

Modern science came into being when scholars began to see the physical world not as the symbolic reflection of another, spiritual world, but as a set of natural causes and effects which could be studied through observation, research and experiment leading to the formulation of new hypotheses. The works of Avicenna turned Western thought in the direction which would give birth to modern science.

The Ancient Greeks had made a synthesis of the then-known cultural values, including those of the Orient. The culture of the Roman Empire assimilated many elements of Hellenism and of the science of the Oriental peoples. Then, in the medieval Orient, came a period which can be compared for brilliance with the European Renaissance. Avicenna was a luminary of this age, but he lived and worked in a cultural and historical setting which had produced other geniuses such as the Persian poets Rudaki and Ferdowsi, the physician Abu Bakr Razi, the astronomer Abu Mahmud Khodjendi, and the encyclopaedists al-Farabi and al-Biruni.

Avicenna sparked off a new cultural movement which, enriched by the invigorating sources of the past, swept westwards from the Orient. First of all it reached Spain; then it spread to the South of France, where it made a contribution to the development of freedom of thought in Europe. This process reached its climax at the time of the Crusades, when Arab and Byzantine cultures once more began to spread in Europe. The thought of Avicenna was thus an essential link in the development and expansion of a unique human civilization.

It would be hard to over-estimate the influence of Avicenna's scientific and

Photo Sergei A. Davidov © Museum of the History of the Peoples of Uzbekistan, Tashkent

Photo © Bibliothèque Nationale, Paris

During the age of Avicenna, the Islamic world was creatively developing the mass of scientific knowledge inherited from the mosaic of cultural traditions it had encountered during its rapid expansion. As well as developing mathematical theories of remarkable accuracy, Muslim astronomers also served the Islamic community's practical need to determine the times of daily prayers at different latitudes and longitudes and to work out the direction of Mecca from every locality where prayers were performed. Avicenna himself made astronomical observations and devised a contrivance for increasing the precision of instrumental readings. The copper astrolabe, above right, was made in Iraq in the 9th century AD. It was used for measuring the height of celestial bodies and hence determining the time of day or night. Above left, iron compasses of the kind a scholar-scientist of Avicenna's time would have used.

Photo A. Piekhanov © Museum of the History of the Peoples of Uzbekistan, Tashkent

This richly decorated ceramic container was used in Central Asia in Avicenna's time for transporting and storing mercury, large quantities of which were extracted and widely used in everyday life. Special metal recipients rubbed with mercury, the only metal which stays liquid at normal temperatures, could be used as mirrors.

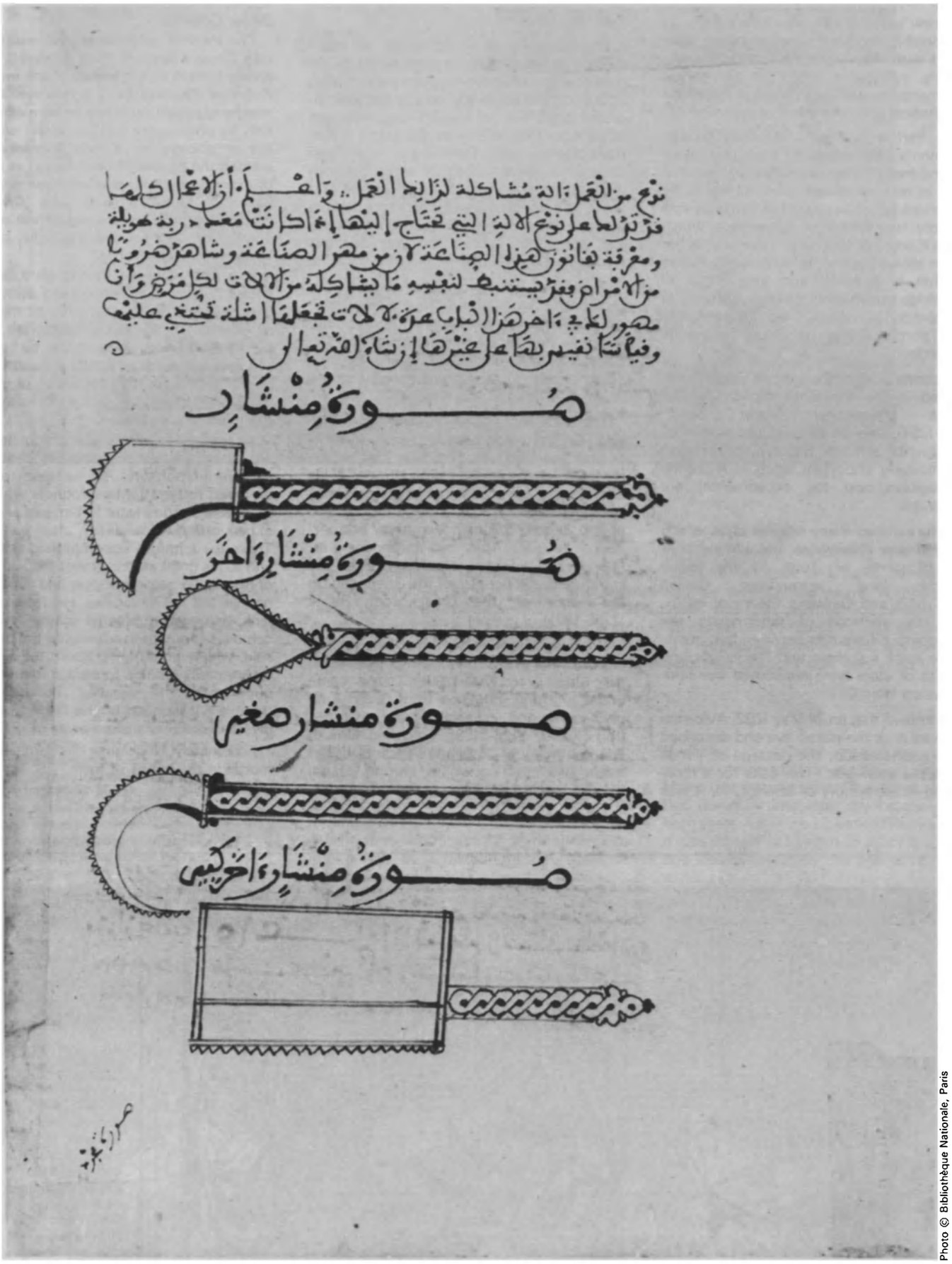


Photo © Bibliothèque Nationale, Paris

Avicenna's *Canon of Medicine* has been called "perhaps the most influential single work in the history of medicine". Written in Arabic, it would later be translated into Persian, Turkish, Urdu and other Islamic languages as well as into Hebrew, Catalan and Latin. But although "the prince of physicians" was the period's most illustrious figure, he did not stand alone, for numerous medical authorities of the highest rank emerged in the Islamic world in the 10th and 11th centuries. One of them was the Arabo-Spanish physician al-Zahrawi (d. c. 1013) known in the West as Albucasis, whose treatise on surgery, profusely illustrated with drawings of surgical instruments designed by the author, became the leading textbook on surgery in Europe for some 500 years. Above, a page from the treatise.

analytical concepts, set forth by one who was both philosopher and man of science, on the development of European thought. He threw new light on Aristotle's logic by considerably modifying the problems connected with the Aristotelian syllogism, envisaging syllogisms based on categorical judgements as well as syllogisms based on hypothetical and conventional judgements.

But that is not all. Interesting though Avicenna's judgements on induction, intuition and many other concepts may be, what needs to be emphasized above all else is the great store he set by logic. For him logic was the very touchstone of knowledge which makes it possible to realize "how what is not known allows itself to be understood thanks to what is known" and also "that all knowledge which has not been weighed in the balance [of reason] is not incontestable and consequently is not authentic knowledge".

Avicenna's contribution to logic was stressed in the thirteenth century by the English philosopher Roger Bacon (1214-1294), one of the first champions of experimental science. Bacon's appreciation is particularly important since in Avicenna the logician and the experimenter are inseparable.

He formulated many original ideas which heralded later discoveries, notably the principle of inertia set forth by the Italian physicist and astronomer Galileo (1564-1642) and Darwin's theory of evolution. His methods of determining the longitudinal differences between two points on the earth's surface and the height and azimuth of stars were reinvented five hundred years later.

It is known that on 24 May 1032, Avicenna observed with the naked eye and described a rare phenomenon: the passage of Venus across the solar disc. This calls for a rectification in the history of science, for it was long thought that this phenomenon had been observed for the first time in 1639 by the English astronomer Jeremiah Horrocks (1617-1641).

If Avicenna was a pioneer in so many fields, it is because he devoted all his life, in medicine and philosophy, poetry and music, education and sociology, to a single goal: increasing the sum of human happiness and goodness. This he saw as the ultimate purpose of philosophy. Believing as he did that there should be "understanding between men, established standards of equity and law", he expressed views which foreshadow the idea of the Social Contract formulated in the eighteenth century by Jean-Jacques Rousseau (1712-1778).

The title of Avicenna's second encyclopaedic work, the *Kitab al-Shifa* (Book of Healing) is particularly appropriate. Whereas the *Canon* dealt with healing the body, the *Shifa* dealt with healing the soul so that men could become morally strong and noble. (See article page 20).

The humanist ideas of Avicenna, who saw in man an innate aspiration towards beauty and harmony, and saw love as the driving force in society, are expounded in his *Treatise on Love* and in his philosophical writings, *Hayy ibn Yaqzan* (The Living, Son of the Dead), *Salaman wa Absal* and *At-Tayr* (The Bird). They had an enriching influence on the later development of the literature of the peoples of the Orient and on the work of the great poet Dante (1265-1321).

Some specialists believe that through the works of the philosopher and scholar Albertus Magnus (c.1200-1280), Dante came under a strong influence from Greco-Arab philosophy and especially from Averroës (Ibn Rushd, 1126-1198), who had himself adopted many of Avicenna's ideas and also made Avicenna known in Europe. Dante himself remarked that he could not cite all those of his predecessors who had influenced him, but did include Avicenna among the figures whose names he mentions in the *Divine Comedy*.

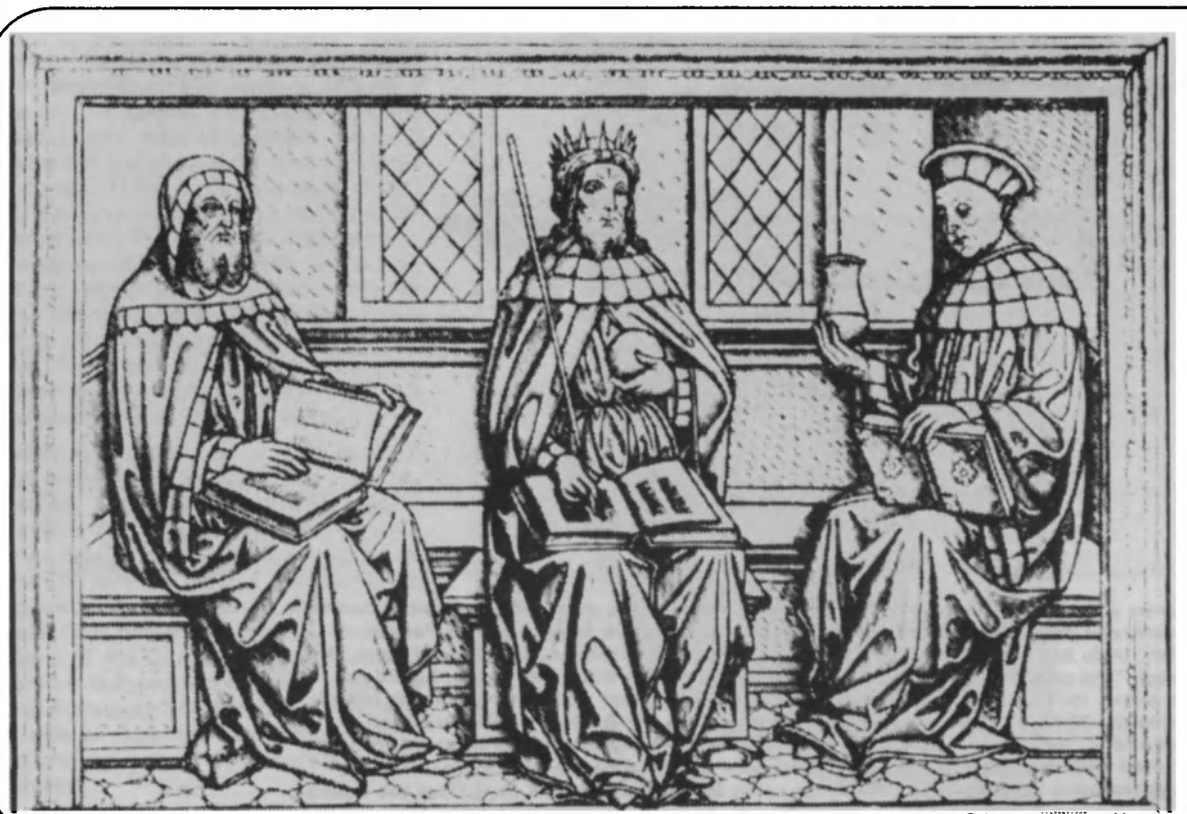
The Persian astronomer and mathematician Omar Khayyam (died around 1123) is widely known as the author of the immortal *Rubaiyat* (Quatrains). It is less well known that he regarded Avicenna as his master, not only in philosophy and the exact sciences but in poetry, for it was Avicenna who created the philosophical *rubaiyat* as a form of expression. A number of these quatrains have in fact survived, and they are remarkable both for the perfection of their poetic form and for the profundity of their thought.

It is also recorded that Omar Khayyam, shortly before his death, read with great concentration the metaphysics of the *Book of Healing*. As for Avicenna himself, when he felt that he was about to die, he freed his servants and distributed all his wealth to the poor. On 18 June 1037 (Ramadan of the year 428 of the Hegira), he died in the desert near the town of Hamadhan.

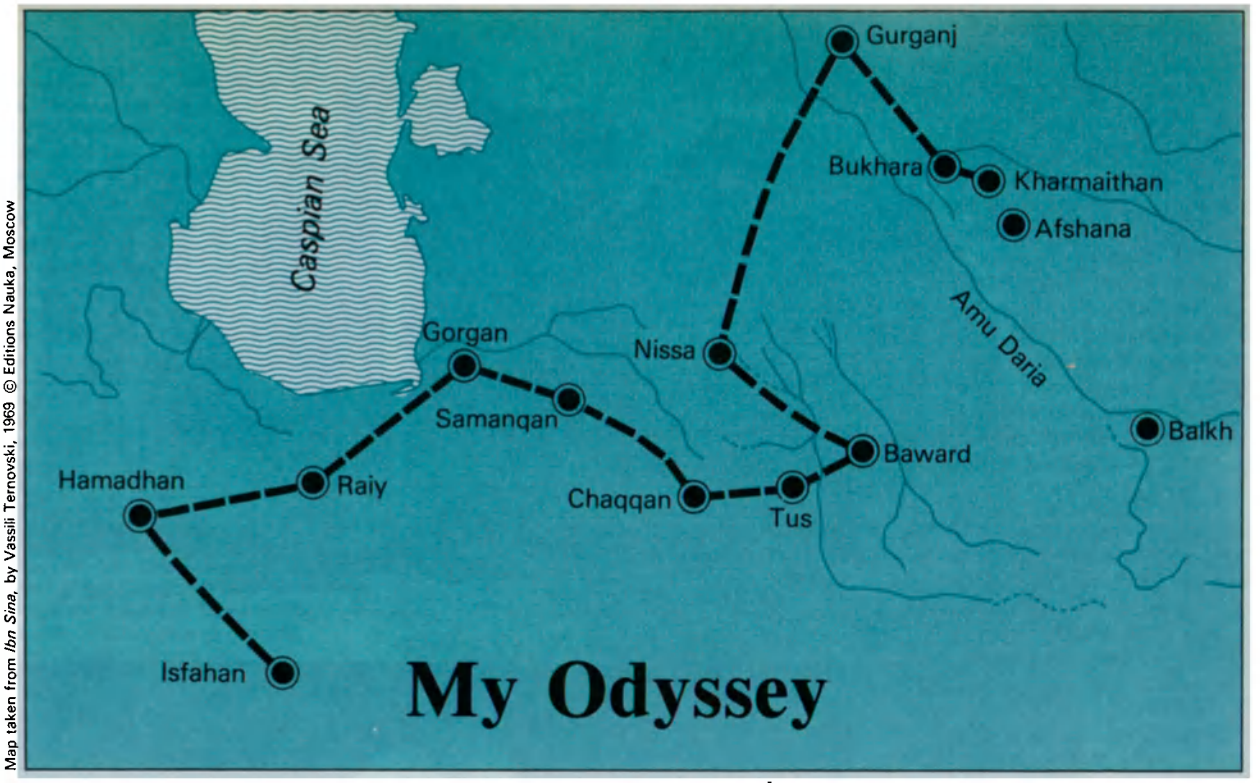
According to one story which has survived, he wished to vanquish death and achieve immortality. He is said to have prepared forty different products which his pupil was to administer to him in a predetermined order, immediately after his death. The pupil faithfully accomplished this task, and to his great astonishment the inert body of his master became supple and youthful as he injected the medicines. His face became pink, he began to breathe again... and then came the moment to administer the last capsule, which would bring about the Master's resurrection. Unable to contain himself, the pupil seized the capsule... but his hands trembled, it slipped from his fingers, and the mysterious liquid soaked away in the sand.

Fortunately, Avicenna has remained immortal in the minds of men.

■ **Muhamed S. Asimov**



Avicenna is seated symbolically between two great physicians of Antiquity, Galen and Hippocrates, in this engraving. The doctrines of Galen and Hippocrates were among the mass of medical lore codified and interpreted by Avicenna.



Map taken from *Ibn Sina*, by Vassili Ternovski, 1969 © Editions Nauka, Moscow

by Avicenna

Our knowledge of the early life of Avicenna (Ibn Sina) is based on a book compiled by Abu Ubaid al-Juzjani, his pupil and companion for twenty-five years. Although the latter part of the book was written by al-Juzjani, the first part, which recounts the great philosopher's life from his childhood until his return to Gorgan, was dictated by Avicenna himself. It paints a vivid picture of a precocious intellect fully aware of his own genius and of the incredible industriousness that brought that genius to fruition.

Above, map showing the travels of Avicenna. Below, this mausoleum, built by the Samanid Emir Ismail I (892-907), is the only building from the time of Avicenna still standing at Bukhara, the city where Avicenna spent his childhood and adolescence and wrote his first scientific and philosophical works.

MY father was from Balkh. During the reign of the Samanid ruler Nuh Ibn Mansur (367-387 AH/ 977-997 AD), he moved from Balkh to Bukhara where he worked as a functionary. He became the Governor of Kharmaithan, the centre of a district in the region of Bukhara, an ancient metropolis. In the vicinity of Kharmaithan is a district called Afshana. He married my mother there and settled down. I, and later my brother, were born there. Later we all went to Bukhara and it was there that I began to study the Koran and *belles-lettres*. By the age of ten I had

Photo © Union of Soviet Associations for Friendship with Foreign Countries, Moscow

reached the end of the Koran and had read much *belles-lettres,* so that people were surprised.

My father was one of those who had responded to the invitation of the Egyptians and was counted among the Isma'ilis. He had accepted their opinions on the soul and on the intellect. My brother likewise. They often discussed these matters. I listened to them, I grasped what they were saying, and they tried to attract me to their rite. On occasion, too, they would discuss philosophy, geometry and Indian arithmetic. Then my father decided to have me learn Indian arithmetic by sending me to a grocer who was in the habit of using that form of calculation.

Meanwhile, one Abu-Abdallah Nateli, who professed a knowledge of philosophy, came to Bukhara. My father invited him to stay with us in the hope that he would teach me. Before his arrival I had visited Ismail Zahid, becoming an assiduous student of Muslim jurisprudence and one of his best pupils. I became familiar with the various methods of argumentation used by the professionals. Later, under Nateli's guidance, I began reading the *Eisagoge* [an introduction to the *Categoriae* of Aristotle by the third-century-AD philosopher Porphyry]. When he explained to me the definition of *genus,* I set about verifying the definition in a manner whose like he had never heard before, so deeply impressing him that he advised my father that I should not engage in any other occupation but learning. Whatever the problem my Master set for me, I succeeded in solving it better than he. I learned from him the rudiments of logic, a science with whose subtleties he had scant acquaintance. From then on I began to read books and study the commentaries on my own, so that I achieved mastery of logic. I also read Euclid's *Geometry,* under Nateli's guidance from the beginning to the fifth or sixth figure; as for the rest of the book, I managed to solve all the difficulties on my own. Then I moved on to [Ptolemy's] *Almagest.* When I had finished the preliminary work and came to the geometric figures, Nateli said to me, "Read it yourself and solve the difficulties; then explain to me what you have read so that I can distinguish for your benefit the true from the false." (The book was beyond the poor man's powers). And so I began to elucidate it by myself, before expounding the questions to my Master. How many were the difficult problems Nateli had not solved until then and which he understood thanks to me!

Then Nateli left for Gorgan. As for me, I applied myself to reading and studying al-Farabi's *Fusus al-Hikam* and other commentaries on physics and metaphysics. As each day went by, the doors of knowledge opened before me. Then I took up medicine and proceeded to read the works that had been written on that subject. Since medicine is not a difficult science, I soon excelled in it and skilled doctors studied it under my guidance. In addition, I cared for the sick practically. Thus the doors of treatment based on experience opened before me, in a way that cannot be described. At the same time I kept up with my studies of religious law and disputation. By then I was sixteen years of age.

During the next year and a half I became increasingly immersed in my studies. I went over logic and all the problems of philosophy

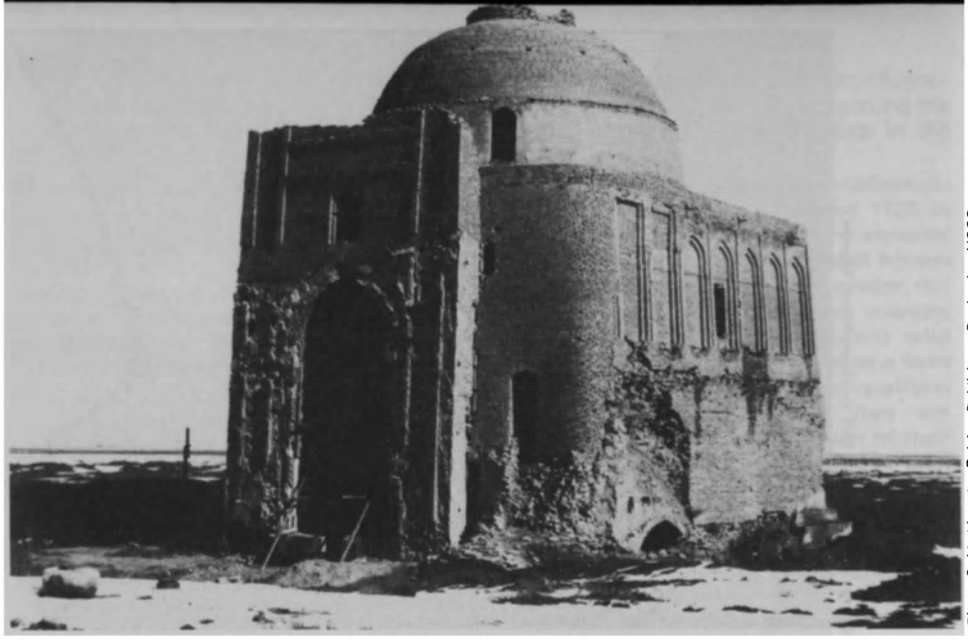


Photo G. Verkhovsky © Irfon Publishers, Dushanbe, USSR

Photo G. Verkhovsky, The Art of Central Asia in Avicenna's Day © Irfon Publishers, Dushanbe, USSR

once again. At that period I did not sleep one night through, and worked all day, acquiring knowledge. I reduced every statement and proposition I came across into its syllogistic premisses; then I examined the possible results of the premisses and observed their conditions until the moment when the correct solution of the problem became indubitable. Whenever I was baffled by a problem, or could not work out the middle term of a syllogism, I repaired to the mosque. I begged and prayed the creator of the universe to reveal to me what had been locked in obscurity and to make diffficulties easy for me. Then, at night, I would return home, set my lamp before me and begin again to read and write. Whenever sleep began to overcome me or I felt exhausted, I drank a frugal glass of wine and waited for my energy to return. Then I began to read again, and when I dozed off I would see in a dream the very same question that I was pondering, so that the solutions to many problems appeared to me in my sleep. I continued unremittingly to follow this routine until I possessed a solid mastery of the sciences and held them in my grasp as far as our human faculties allow. Everything I learned at that time is not replaced by what I have learned more recently, even until today. Thus I mastered logic, the natural sciences and mathematics.

Then I returned to the study of the divine science. I read [Aristotle's] *Metaphysics,* but without understanding a word of it. The author's intentions remained lost in obscurity to me. Although I read the book forty times from end to end until I knew it by heart, I could grasp neither its meaning nor its purpose. I despaired of understanding it by my own efforts and said to myself: "This book is incomprehensible". Then one day I was walking through the book bazaar when a bookseller proffered me a book whose price he was shouting out. Discouraged as I was, I rebuffed him, convinced that there was nothing to be gained from this science. The vendor stood his ground and said: "Buy this book. It is cheap. I am selling it off for three dirhams because its owner is in needy circumstances." And so I bought it. The book turned out to be Abu Nasr al-Farabi's

Avicenna's pleasant life at Gurganj came to an abrupt end when Sultan Mahmud of Ghazna demanded that the brilliant group of artists and philosophers gathered under the protection of Emir Ali Ibn Ma'mun be sent to grace his own court. Avicenna was unwilling to comply and, to avoid the Sultan's clutches, was obliged to flee Gurganj. Travelling farther and farther westwards, he crossed the Karakum desert eventually reaching Nissa. Not far from Nissa at the present-day town of Meyhana, stands the mausoleum (photo top left) of the *sufi*, or Muslim mystic, Abu Said, whom Avicenna is thought to have known and from whom he may have acquired a knowledge of Islamic mysticism. Another of Avicenna's stopping-places was Meshked-i-Misriana, then a beautiful and populous town whose ruined minarets (photo bottom left) today rise like a mirage from the desert. After many other vicissitudes Avicenna at last reached Isfahan where he became physician and adviser to the Emir. Here, at the peak of his career, he wrote in his native tongue, Persian, one of his major works—the *Book of Knowledge*. Photo right, the soaring arches of the Friday Mosque at Isfahan. Worn out by his travels and the hardships and alarums of an eventful life, Avicenna died, in August 1037, on the desert road between Isfahan and Hamadhan, to which city his body was taken. Today, his remains are at rest in a new mausoleum (photo bottom right) built during the 1950s by Iranian architect Khusheng Saihun. The mausoleum houses a huge library. Twelve columns form a thirty-metre-high tower supporting a cone-shaped roof. They represent the twelve branches of learning in which the genius of Avicenna found expression.

Photo Jean Mazenod, *L'Islam et l'Art Musulman* © Editions d'Art, Lucien Mazenod, Paris

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Commentaries on the Metaphysics. I rushed home and read it. The whole purport of [Aristotle's treatise] straightaway became clear to me because I already knew the work by heart. In a transport of delight, I began the following day to distribute abundant alms to the poor as a thanksgiving.

At this time the Emir Nuh Ibn Mansur, the ruler of Bukhara, was afflicted with a serious illness which the doctors were unable to cure. I was renowned among these physicians for the range of my studies. They suggested to the prince that he should summon me. So off I went and joined the other physicians who were treating him. And I distinguished myself in his service.

One day I asked him to grant me access to his library, to examine the books there and to read the medical works. He agreed to my request. I made my way into a mansion with many chambers, with chest upon chest of books in each. Each room was devoted to a single subject, one room containing works of literature and poetry, another works of jurisprudence. I perused the catalogue of books of the Ancients and asked for all ▶

those I needed. Among them I saw books whose very names were unknown to many—works which I had never seen before and have not seen since.

I read these books, profiting from them and acquainting myself with each author's rank in his own field of knowledge. At the age of eighteen, I had finished studying all these sciences. At that period my knowledge was due above all to my memory; today I am more mature, otherwise my knowledge is exactly the same and nothing has changed.

A neighbour of mine called Abu'l Hassan al-Aruzi asked me to write a scientific encyclopaedia for him. In answer to his request I wrote the *Majmu* (Compendium) which I signed in his name and in which I covered all the sciences except mathematics. I was then twenty-one years old. Another neighbour of mine was a native of Khorezm named Abu Bakr al-Baraqi. He had no equal in jurisprudence, Koranic exegesis and asceticism and had a strong leaning for the speculative sciences. He asked me to write a commentary on these scientific works and so I wrote *al-Hasil wa al-Mahsul* (The Import and the Substance) in about twenty volumes. I also wrote for him a work on ethics which I called *al-Birr wa al-Ithm* (Good Work and Evil), works which can only be found at his dwelling and which he never lent out for copying.

Then my father died and my circumstances changed completely. I accepted a post in the Sultan's employment and had to move from Bukhara to Gurganj. The vizier of the ruler of Khorezm, Ali Ibn Ma'mun, was a learned man by the name of Abu-l Husain as-Soheili. I presented myself to this ruler, wearing the clothing appropriate to jurists, with scarf and chin-wrap. A monthly salary, in keeping with my talents, was fixed. Some time afterwards, again constrained by necessity, I moved from Khorezm to the confines of Khorasan, passing through Baward, then Tus then Shaqqan, then Samanqan, then Jajarm and thence to Gorgan. My entire purpose was to reach the Emir Qabus; but it happened at that moment that Qabus was taken and imprisoned in a fortress, where he died. After this I went to Dihistan where I fell very ill, then returned to Jurjan where Abu Ubain al-Juzjani made friends with me; and I composed a poem on my condition in which there is a verse saying:

And great once I became, no more would city hold me,
And when my value rose, no one would care to buy me. ■

Milestones in a restless life

• 980 AD (370 of the Hegira), birth of Avicenna (Abu Ali al-Husayn Ibn Abd-Allah Ibn Hassan Ibn Ali Ibn Sina) near the city of Bukhara (in the present-day Soviet Socialist Republic of Uzbekistan) in a village of which his father was governor. As a very young child, begins to learn Arabic and the Koran.

• The family soon moves to Bukhara. By the age of ten, Avicenna can recite the 114 chapters of the Koran from memory.

• Under the guidance of gifted teachers, Avicenna extends the range of his knowledge to a prodigious degree. His last tutor, the philosopher Nateli, leaves because he has nothing more to teach him.

• At sixteen years of age Avicenna has won a reputation as a doctor and is beginning to attract a growing stream of patients.

• Around the age of eighteen he has already assimilated all the knowledge of his time in theology, Arabic literature, geometry, mathematics, physics, logic and philosophy.

• Succeeds, where all other physicians have failed, in curing the Samanid Sultan of Bukhara, Nuh Ibn Mansur; wins the Sultan's favour and is rewarded with access to his library.

• While at Bukhara writes his first works, notably *al-Hasil wa al-Mahsul* (The Import and the Substance) and *al-Birr wa al-Ithm* (Good Work and Evil).

• In the year 1001 AD (392 of the Hegira) the Samanid State is threatened by the powerful Sultan Mahmud of Ghazna (in present-day Afghanistan). Avicenna sets out for Gurganj, capital of Khorezm (in what is now the Turkmen SSR) whose vizier Abu-l Husayn as-Soheili is a lover of learning. The Emir of Gurganj, Ali Ibn Ma'mun, has gathered around him a galaxy of illustrious scholars including the renowned al-Biruni, Abu Nasr al-Arraq, the Christian Abu Masihi, and Abul Kheir al-Khammar.

• After a short stay, Avicenna is obliged to leave Gurganj when the Sultan of Ghazna demands that all the Gurganj scientists be sent to his court. Prince Ma'mun is forced to yield to his powerful neighbour, but Avicenna, accompanied by the Christian Masihi, who will not survive the journey, leaves for Gorgan, southeast of the Caspian Sea.

• While at Gorgan meets Abu Ubaid al-Juzjani who (until Avicenna's death a quarter of a century later) will be his most faithful disciple and his biographer.

• For two years Avicenna devotes himself to study and writing. Finishes *al-Mabda wa al-Ma'ad* (The Beginning and the Return) and embarks on one of his masterworks, the *Canon of Medicine.*

• Leaves Gorgan and journeys to the city of Raiy (whose ruins today stand southwest of Teheran), the capital of prince Majd el-Dowleh. Avicenna treats the prince and cures him.

• In 1014 AD (405 of the Hegira) leaves Raiy and settles near Hamadhan.

• Avicenna, whose reputation has preceded him, is summoned to the bedside of prince Shams el-Dowleh, who appoints him vizier (prime minister).

• After being toppled by an army mutiny, Avicenna is reinvested as grand vizier, and for the next six years lives a relatively stable life governed by a crushing work-timetable.

• Begins his great encyclopaedic work on philosophy the *Shifa* (The Book of Healing). Rises before dawn, teaches his pupils in the early morning, leads them to prayers as an Imam, writes fifty pages a day of the *Shifa.*

• In 1021 AD (412 of the Hegira) his protector, prince Shams el-Dowleh, dies, and his son refuses to reinvest Avicenna as grand vizier. Goes into hiding where he virtually completes the *Shifa,* without, as he would later point out, reference to written texts and relying entirely on his prodigious memory.

• A secret letter to the ruler of Isfahan, prince Ala el-Dowleh, is intercepted, Avicenna's hiding place is revealed and he is cast into prison with his faithful disciple Juzjani. During four months in prison writes the *Risalat Haiy ibn Yaqzan* (The Treatise of Living, the Son of the Vigilant), the *al-Hidaya* (The Book of Guidance) and the *al-Adwiyat al-Qalbiyya* (The Cardiac Remedies).

• After a war between princes Sama el-Dowleh and Ala el-Dowleh, in which the latter is victorious, Avicenna is released but is obliged to live at Hamadhan.

• In 1023 AD (414 of the Hegira) flees to Isfahan accompanied by the faithful Juzjani.

• At Isfahan, the final stage in Avicenna's tumultuous odyssey, the philosopher spends the last fourteen years of his life under the protection of prince Ala el-Dowleh.

• Works on astronomy, and so the story goes, writes the *Book of Knowledge* at the prince's request. Adds a chapter on music to the *Shifa* and writes a work on linguistics entitled *The Language of the Arabs.*

• During a campaign waged against Hamadhan by Ala el-Dowleh, Avicenna is seized by a severe attack of colic which he tries to cure too quickly.

• Dies on the first Friday of the month of Ramadan, 428 of the Hegira (August 1037 AD), aged fifty-seven.

The Canon of Medicine

A million-word thesaurus of medical knowledge

by Hakim Mohammed Said

GREEK medicine reached the Muslim world before philosophy, via the medical school at Jundishapur. During the Ummayyad age (41-132 AH/661-750 AD) a Persian Jew, Masarjawaih, translated the Pandects (treatises) of Ahron into Arabic. Ahron was a Christian monk who lived in Alexandria not long before the Arab conquest.

This was followed by Mesue the Elder's *Jawahir al-Tibb al-mufrada* (The Essential Features of Drug Simples) and translations during the Abbasid age (132-656 AH/750-1258 AD) by Hunayn, who, if his claim is to be given credence, translated some of Hippocrates' works (including his Aphorisms), the whole of Galen's original works and some of his commentaries on Hippocrates.

The age of translation was followed by a period which saw the production of some original works of high order in medicine. Ali Ibn-Sahl Rabban al-Tabari (833-923 AD) produced his *Firdaws al-Hikmah* (Paradise of Wisdom). It included some philosophy and other disciplines like astronomy, but broke new ground in that it included not only Greek but also Hindu sources.

Tabari was followed by an even greater figure, al-Razi (865-923 AD) who has been called "the greatest and most original of Muslim physicians, and one of the most prolific as an author". Unlike Avicenna's *Canon,* his *Kitab al-Hawi (Continens)* is not a theoretical work but a record of clinical experiences. Although he was interested in philosophy, al-Razi mostly wrote treatises of a practical nature, e.g., *Smallpox and Measles; On the fact that even skilful physicians cannot heal all diseases;* and *On why people prefer quacks and charlatans to skilled physicians.*

Thus there existed a whole tradition of medical writing when Avicenna's (Ibn Sina's) *Canon of Medicine* appeared. The literal meaning of *Qanun* (Canon) is codes of laws and series of principles. Avicenna therefore wrote the work not as an encyclopaedia of the knowledge of his own time but as knowledge based upon reasoning, logic, and principles. According to one authority, "Numerous passages occur in the *Canon* which show that it is a series of notes

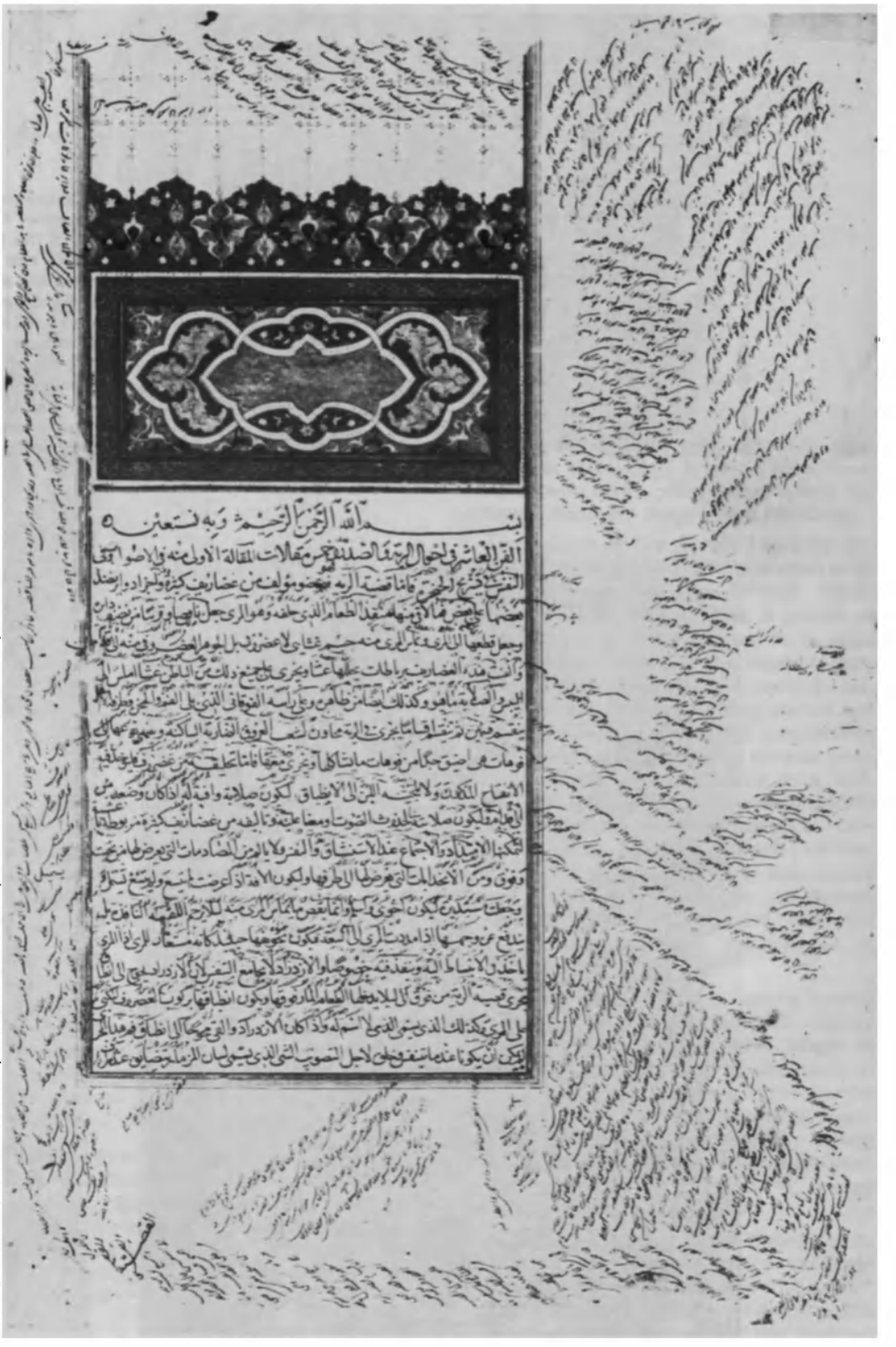

Photo © Oriental Institute of the Academy of Sciences of Uzbekistan, Tashkent

Above, first page of Part 10 of Book III of Avicenna's *Canon of Medicine,* in the form of a richly ornamented manuscript in *naskhi* (cursive Arabic script) dating from 1601 AD. Each part opens with a multicoloured *unvan* or illuminated heading and the text is framed with a border of gold or coloured lines. The marginal notes suggest that the manuscript was once in the possession of an industrious and attentive student.

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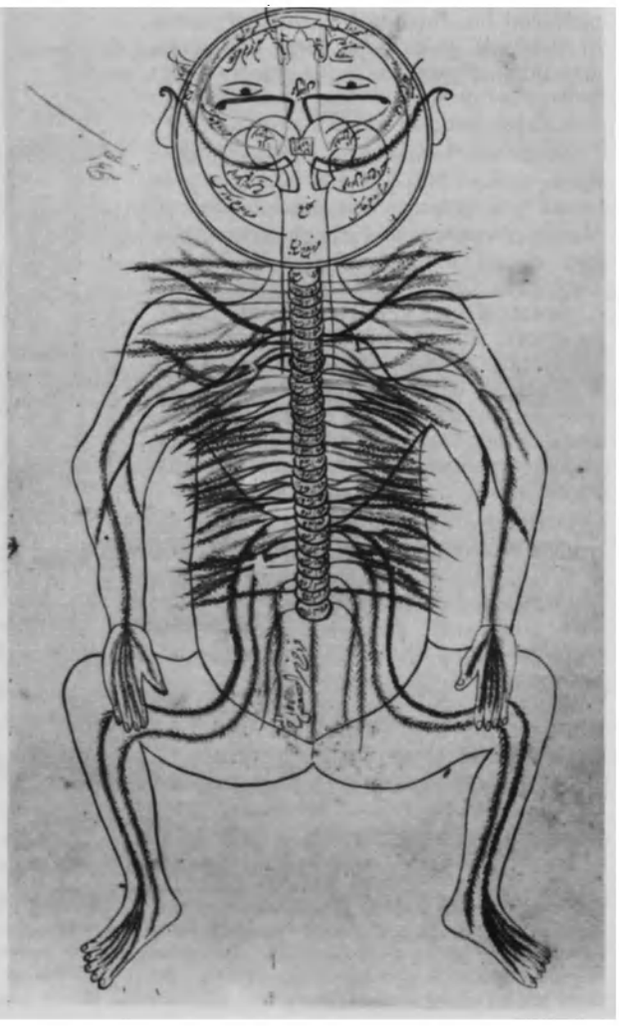
Photos by courtesy of the Wellcome Trustees, London

Diagrams on this page, depicting (below) the nervous system, (bottom left) the human skeleton and (left) the muscles, are from a Persian manuscript of the *Canon of Medicine* dating from 1632 AD. The text accompanying the anatomical drawing (right) by Leonardo da Vinci, in the artist's famous "mirror-writing", refers specifically to Avicenna. "The elements of the foot number sixty", he wrote, using Avicenna's exact terms.



or skeleton outlines, not too lengthy to be memorized by his pupils".

The work comprises five volumes. The first volume discusses the general principles. It defines medicine and discusses the scope of medicine, followed by discourses upon temperament, temperament of organs, temperament of age and sex, nature and variety of humours, diseases of the organs, muscles, nerves, arteries and veins, faculties and functions, diseases and their aetiology, signs and symptoms, pulse, urine, regimens to be followed for different ages, preventive medicine, management of temperamental abnormalities, effect of climate, and treatment.

The second volume consists of two parts. The first part discusses the determination of the temperament of drugs by experiment and influence. Conditions for research into drugs are laid down, e.g. the experiments to be conducted on the human body, freedom of the drug from extrinsic and intrinsic alterations, trial to be on an allopathic basis and made in simple diseases, and determination as to whether the drug is qualitatively and quantitatively appropriate to the nature and severity of the disease, and so on. General principles regarding drug action and methods of collecting and preserving various drug products are described as well. The second part lists 760 drugs arranged alphabetically.

The third volume discusses the aetiology, symptoms, diagnosis, prognosis and systematic treatment of diseases. It describes diseases of the head, e.g. abnormal temperaments of the brain, and headache, epilepsy, paralysis, etc., diseases of the eye, nose, ear, and throat; diseases of the alimentary tract, genito-urinary system, diseases of the muscles, joints, and feet.

The fourth volume treats of general diseases. Part I deals with fevers and their treatment, Part II with boils and swellings, leprosy, minor surgery, wounds and their general treatment, injuries, ulcers and glandular swellings, Part III with poisons, and Part IV with "beauty culture".

Volume V is an *aqrabadhin* (the Arab equivalent for formulary). A notable predecessor to Avicenna's work is the formulary by the Arab philosopher al-Kindi (800-873 AD). It comprises description of special prescriptions and antidotes, methods of preparing pills, pessaries, suppositories, powders, syrups, decoctions, confections, elixirs, etc., prescriptions for different diseases; weights and measures.

The impact of the *Canon* has been immense. Translated into Latin a century after its appearance by the famous Italian translator Gerard of Cremona, it gained so much popularity that in the last thirty years of the fifteenth century it was issued sixteen times and more than twenty times in the sixteenth century. It was still being printed and read in the second half of the seventeenth century, and was consulted by medical practitioners regularly. It continued as a textbook until 1650 in the Universities of Montpellier and Louvain. The medical curriculum in Vienna and Frankfurt-on-the-Oder, in the sixteenth century, was largely based on the *Canon* and the *Ad Almansorem* of al-Razi. The noted Avicenna scholar Soheil M. Afnan, speaking of its popularity, remarks:

"The translation of the *Canon* by Andrea Alpago (d. 1520) of Italy was followed by even later versions which were taught in various European universities, especially in Italy and France. It was not until human dissection came to be allowed that European anatomists detected certain anatomical and physiological errors of Galen which had been transmitted to Europe through the works of Avicenna."

A special feature of the *Canon* is its broadness and catholicity. It has now been established beyond doubt that Ayurvedic* works had become available in Arabic in the seventh century, and during the Abbasid period Salih Ibn Duhn and the Hindu

* Ayurveda is the traditional Hindu system of medicine based largely on homeopathy and naturopathy.

astronomer Mankah were the transmitters of this tradition. Some descriptions in the *Canon*, such as those of the pulse, are reminiscent of the Chinese system.

A major contribution of Avicenna is to the aetiology of disease. Taking his cue from Aristotle, he believes that complete knowledge of a thing is possible only if we take into account the material of which a thing is made, the "efficient cause" that moulds it, the "formal cause" which determines its shape and quality, and the "final cause" or function for which a thing is made. Avicenna introduces a theory in which the concept of the elements symbolizes qualities of mass and energy at the same time and interaction between the four causes. He thus establishes not only the unity between organs and functions in the body but also brings the body and the outer world in appropriate space-time relationship.

Now the human body is material but is vivified by the vital force. The vital force is a life-principle organized from the humours. He defines psyche as expressing itself as mind at the cognitive level and as emotions in the heart and thus an integral part of the body.

This concept of causation, then, implies that the internal organs belong to each other beyond the anatomical limits. Anatomy regards the heart as a circumscribed organ while for Avicenna it is the part of force occupying the whole of the body.

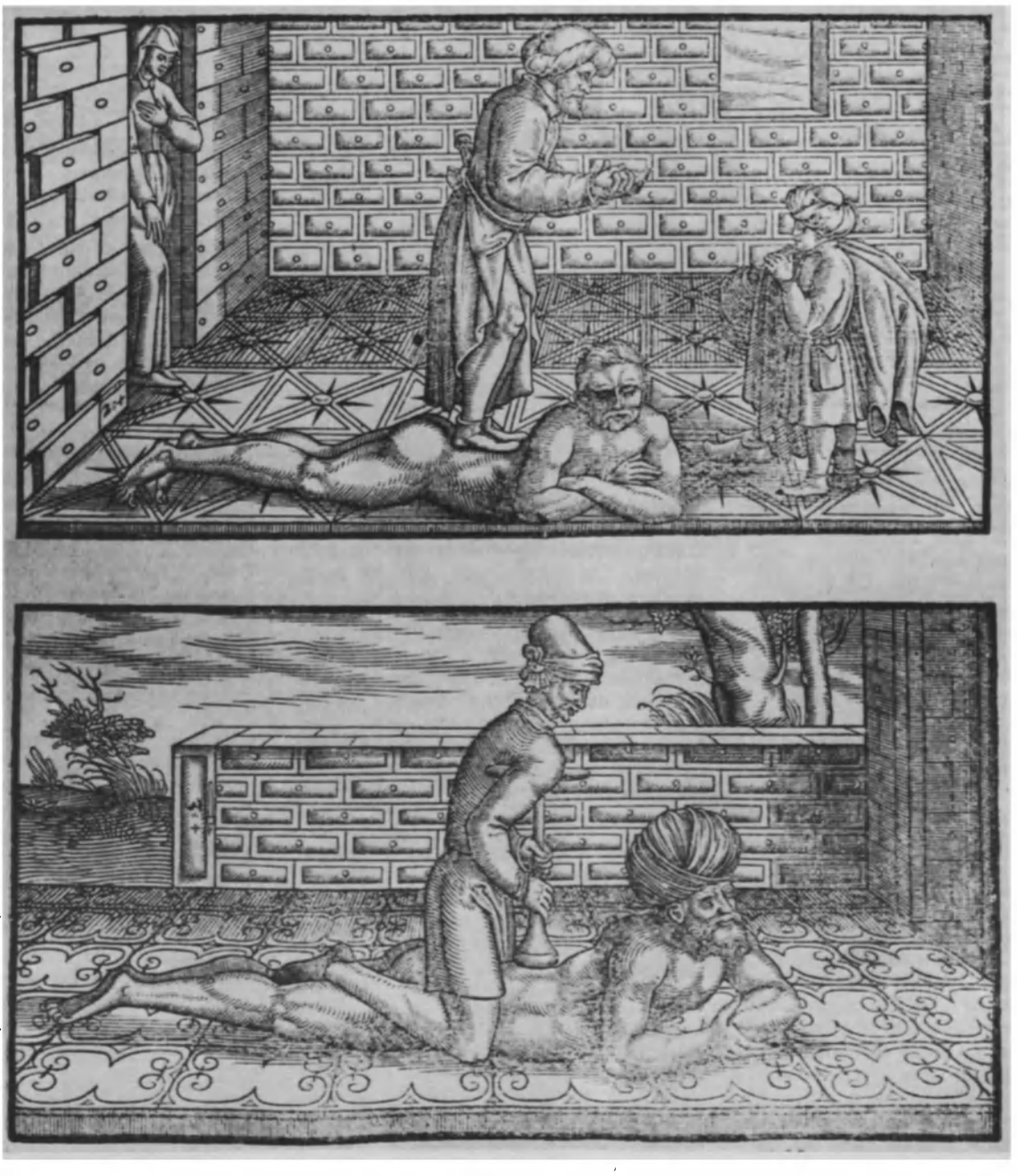
If we combine the ancient with modern knowledge, we might just as well say that the arterial vessels with the blood contained in them and the autonomic nervous system including its hypothalamic centre are one great composite of the functional heart whose operation pervades the whole body.

The *nafs* in Avicenna is *anima*, which, in accordance with the nature of an organism, acts as the ultimate determinant or formative factor for its growth and activity. The basic thesis with Avicenna is thus that the whole is greater than the sum of its parts and that man is a dynamic organism, with each individual having his own unique temperament. His dynamism cannot be explained on the basis of analysis.

With the help of these concepts Avicenna offers a constitutional approach according to which disease is to be explained in terms of the individual's genetic structure; the kind of temperament, structure, and strength of faculties possessed by him; environmental factors; and Nature's own effort at the restoration or maintenance of his life-functions.

The concept of the elements in Avicenna, in which heat and cold are two opposite types of energy, and dryness and moisture are two opposite qualities of mass, is to be found in Aristotle. Avicenna's elaboration of the Aristotelian thesis has been translated as follows: The truth is that the first principles behind all generable and corruptible substances are primary, active or kinetic energies and occur either simply in fire, air, water and earth or linked to a composite

Illustrations from an edition of the *Canon of Medicine*, dating from about 1520 AD, show methods of treatment for various spinal disorders. While Avicenna broadly followed Hippocrates' methods for the extension of the vertebral column in the treatment of displaced vertebrae, the use of a specially designed instrument (lower illustration) for putting a displaced vertebra back in place was his own invention.



Left, double-ended instrument used by pharmacists in Avicenna's day in the preparation of medicines; one end consists of a spoon and the other of a small strainer. Below, 10th to 12th-century bronze medicine phial discovered in Uzbekistan.

Photos Sergei A. Davydov
© Museum of the History of the Peoples of Uzbekistan, Tashkent

Photo © Oriental Institute of the Academy of Sciences of the Tadzhik SSR, Dushanbe

Avicenna's contribution to pharmacology was original and important and he is credited with introducing many previously untried herbs into medical use. Book II of his *Canon of Medicine* dealt with pharmacology, including the collection and preservation of medicinal herbs, and formed the basis of many subsequent works on this subject. Above, excerpt from a manuscript known as *The Gift of the Believers,* written by Mohammad Dailani, physician at the court of Shah Ismaili (1686-1694). The illustration is of *Fasafis,* a plant resembling the lentil, which was used to cure disorders of the throat and liver and as an antidote to snake-bite.

temperament. The late Dr. Mazhar H. Shah observed that, according to Avicenna, the organization of various objects in nature is the result of an interaction of the four qualities of mass and energy and that the four elements mentioned in the *Canon* are merely symbols employed to understand the various actions and reactions of the body and its environment in qualitative terms. Ayurveda has three temperaments: *Vata, Pitta,* and *Kapha*—as propounded by Charak and Sushruta. Hippocrates has also three temperaments—apoplectic, phlegmatic, and melancholic.

Galen propounded four temperaments —sanguine, choleric, phlegmatic, and melancholic. Avicenna formulated four temperaments—hot and moist, hot and dry, cold and moist, and cold and dry.

Since then several temperaments have been formulated, among those that are well-known being those due to Eppinger and Hess (1917 and 1931) and Pavlov. The former formulated two temperaments, sympatheticotonia and vagotonia, while Pavlov propounded four temperaments —lively, impetuous, calm, and weak. These four types correspond exactly to the Galenic classification of temperament into the sanguine, choleric, phlegmatic, and melancholic types.

The "heart" in Avicenna's system is not just the structural heart described by the anatomists but the "functional" heart which, as the centre of emotions, thermoregulation, sleep and water metabolism is centred in the diencephalon, a portion of the brain which in the phylogeny of the race was the first to develop. The pituitary gland which subserves as well as regulates the functions of this region may also be included in the concept of the "heart". In *De Viribus Cordis* (paragraph 172) Avicenna says:

"The foundation or beginning of all these faculties is traceable to the heart, as is agreed upon even by those philosophers who think that the source of visual, auditory and gustatory power lies in the Brain."

The *Canon* abounds in original observations made by Avicenna during the course of medical practice, e.g. the distinction of mediastinitis from pleurisy; the contagious nature of phthisis; the diffusion of disease by water and soil; sexual diseases and perversions; nervous diseases; and careful description of the diseases of the skin. The *materia medica* describes about 760 drugs and Avicenna has outlined pharmacological methods. The book on *materia medica* and pharmacology contains a passage upon experimentation which according to the French scholar A-M. Goichon, sets out the three methods—agreement, difference, and concomitant variations—which are usually associated with the modern scientific approach.

The *Canon* remained far more accessible than the works of Hippocrates, even though Arnold of Villanova (1235-1312) described Avicenna as a "professional scribbler" whose misinterpretation of Galen stupefied European physicians. Ibn Zuhr (Avenzoar) of Spain described the *Canon* as "waste-paper". Such criticism belittles the critics rather than the *Shaykh al-Rais*. If he stupefied the European physicians, why should be have been studied in Europe at all and why did not European scholars come out with their own interpretations of Galen? Nor is the historian of science George Sarton's contention that "His triumph was too complete; it discouraged original investigations and sterilized intellectual life", correct for there were many notable physicians, surgeons, and scientists after him among the Muslims.

■ **Hakim Mohammed Said**

Notes and nostrums from Dr. Avicenna's casebook

by Ahmed Aroua

FROM examination of the character and writings of Avicenna (Ibn Sina) there emerges a picture of that perpetual search for balance and unity that is characteristic of Arabo-Islamic culture. There is no contradiction, nor should there be, between body and mind, between the individual and society, between science and faith, between nature and man.

The medical arts as propounded by Avicenna are free of all those harmful and irrational explanations with which the medicine of Antiquity was blemished and which can still be found in certain practices of modern fringe medicine. With Avicenna medicine became a science.

He divided medicine into "theoretical" and "practical" medicine, the latter being sub-divided further into "curative" and "preventive" medicine. Attaching as he did great importance to preventive medicine, Avicenna listed the following areas in which it should be applied:

"The essential considerations in the art of preserving the health consist in maintaining equilibrium between various concomitant factors. But there are seven matters concerning which special care must be expended to ensure just proportion: Equilibrium of the temperament; Selection of the articles of food and drink; Evacuation of effete matters; Safeguarding the composite; Maintaining the purity of the air respired; Guarding against extraneous contingencies; Moderation in regard to the movements of the body and the motions of the mind, which include sleep and wakefulness."

With his view of health as a dynamic concept affecting the whole person, Avicenna took into consideration questions of age, temperament, constitution, climate, and the psychosomatic duality of the individual.

He devoted many pages of the *Canon* to the safeguarding of the health of the infant:

"Bathing the infant. In summer time it should be bathed in suave, tepid water. In winter the water should be on the warm side. Whenever possible the mother's milk should be given and by suckling. For that is the aliment of all others most like in substance to the nutrient material which the infant receives while in the womb. Experience shows that merely to place the mother's nipple into the infant's mouth is a great help towards removing whatever is hurtful to the infant."

Ahead of his time in many areas of medicine, Avicenna was especially conscious of the importance of physical exercise:

"Now exercise is that agent which most surely prevents the accumulation of these matters and prevents plethora. It is this exercise which renews and revives the innate heat and imparts the necessary lightness to the body. For it causes the subtile heat to be increased and daily disperses whatever effete substances have accumulated. To forsake exercise would often incur the risk of 'hectic', because the faculties of the members are impaired inasmuch as deprivation of movement prevents the access to them of the innate breath. And this last is the real instrument of life for every one of the members."

Avicenna also laid great stress on the effect of sleep on mental activity:

"Sleep in moderation assists the vegetative faculties in their functions and brings the sensitive faculties into repose and in so doing restores them and thereby arrests the dissipation of the breath. The good qualities of sleeping by night are that it should be continuous and deep. It is also bad to go to sleep during the day. The best sleep is that which is deep and that which occurs after the food has passed on from the upper part of the intestine."

The *Canon* also offers much advice on the effect on man of the air he breathes and of his environment:

"As long as the air is attempered and pure and has no substances admixed which would be contrary to the temperament of the breath, health will come and remain. Otherwise the contrary occurs. The substance of the air is good when it is not contaminated with extraneous matter such as the vapours from marshes and lakes or canals and open sewers or the gaseous products from chemical works or smoke or soot. Air is good when it does not interfere with one's breathing or cause the throat to contract."

Avicenna expressed in the *Canon* his views on the effects of climate and the seasons on human health:

*"**Spring.** When the temperament of the spring conforms to type, it is a very healthy season. Diseases of the spring: Inflammatory deposits, carbuncles, anginas, abscesses of various kinds. There may be haemoptysis and troublesome coughs. Puberty and the time of life thereabout are benefited by the spring".*

*"**Summer.** In summer: the humours are dispersed. The faculties and natural functions are impaired owing to the excessive dispersion. The blood and serous humour are diminished and the bilious humour increases. Diseases of the summer: if very hot, tertian and burning fevers, emaciation, pains on the ears, ophthalmia. Erysipelas is common, also furunculosis; if spring-like, mild benign fevers. Rheumatisms and catarrhs also occur. Old people and those of similar nature feel stronger in summer."*

*"**Autumn.** The autumn season brings many diseases for these reasons: there is exposure to sun by day and the nights are cold. The blood is much less in amount because this season is contrary in temperament to the blood. Diseases of autumn: fevers, rheumatisms and sciatica, oliguria and dysuria, angina, worms.*

*"**Winter.** Winter is a help for digestion. Diseases of winter: coryza, pleurisy, pulmonary infection, hoarseness and sore throat, pains in the chest, side, back and loins, apoplexy and epileptic seizures. Winter is inimical to old persons."*

The views expressed by Avicenna on matters of housing and public health have an astonishing topicality since today these problems face urban authorities in aggravated form:

"Characters upon which the effect of habitable regions on people depends: whether high or low-lying; type of adjoining country, whether open or sheltered; state of soil; whether the water is plentiful or scarce, stagnant or flowing; local factors, trees, mines, cemeteries, putrescent pools, etc."

Finally, it is perhaps somewhat surprising to find a physician of the year 1000 AD giving careful instructions about the hygienic precautions to be taken before operations, a matter which was generally treated very lightly as late as the 19th century:

"The greatest care must be taken during surgical operations to prevent infection, because a wound can only be treated in the absence of infection. Should infection or contusion occur, it will accumulate at the wound which will suppurate, making surgical intervention impossible until it has been treated. If the blood in a wound becomes infected it must be got rid of as quickly as possible."

■

AHMED AROUA *is an Algerian medical doctor and poet. These extracts from Avicenna's* Canon of Medicine *and the accompanying commentaries appeared in his book* Hygiène et Prévention Médicale chez Ibnou Sina (Avicenne) *(Hygiene and Preventive Medicine in Ibn Sina [Avicenna]), 1974.*

AVICENNA AND THE LOVESICK YOUTH

In this 15th-century miniature, Avicenna is seen at the bedside of an ailing young nobleman. It illustrates an incident in Avicenna's life which reveals that he was no less aware than modern physicians of the psychosomatic nature of certain illnesses.

For many months a young nobleman lay sick unto death of a strange malady against which the potions and cures proposed by the learned doctors called in to treat him were of no avail. In despair, his relatives summoned to his bedside the most famous doctor in the land. When Avicenna (for he it was) arrived, he examined the ailing youth briefly and then asked to be left alone with him. Holding the patient's pulse he said: "Tell me, my son, about yourself, your life, your relations with your family, your plans for the future." "I am very ill and like to die", was all the youth's reply. "Do not upset yourself like this, you will surely live", replied Avicenna. "Tell me, what think you of women?" And, feeling the youth's pulse quicken, he went on: "Has your heart never been captivated by a woman's beauty?" "No, no", exclaimed the youth hotly. "Why do you say 'No' to me", said Avicenna, "When your whole body cries out the answer 'Yes'? What is the maiden's name?" Finally, after a long silence, the young man spluttered out the name of his beloved. Avicenna summoned his parents and announced solemnly: "The patient is suffering from an incurable disease. He is lovesick and fears to tell you of the woman who has won his heart. There is but one cure—marriage". Some days later, after the wedding festivities were over, Avicenna returned home, leaving the young nobleman in the care of his new wife and fully restored in mind and body.

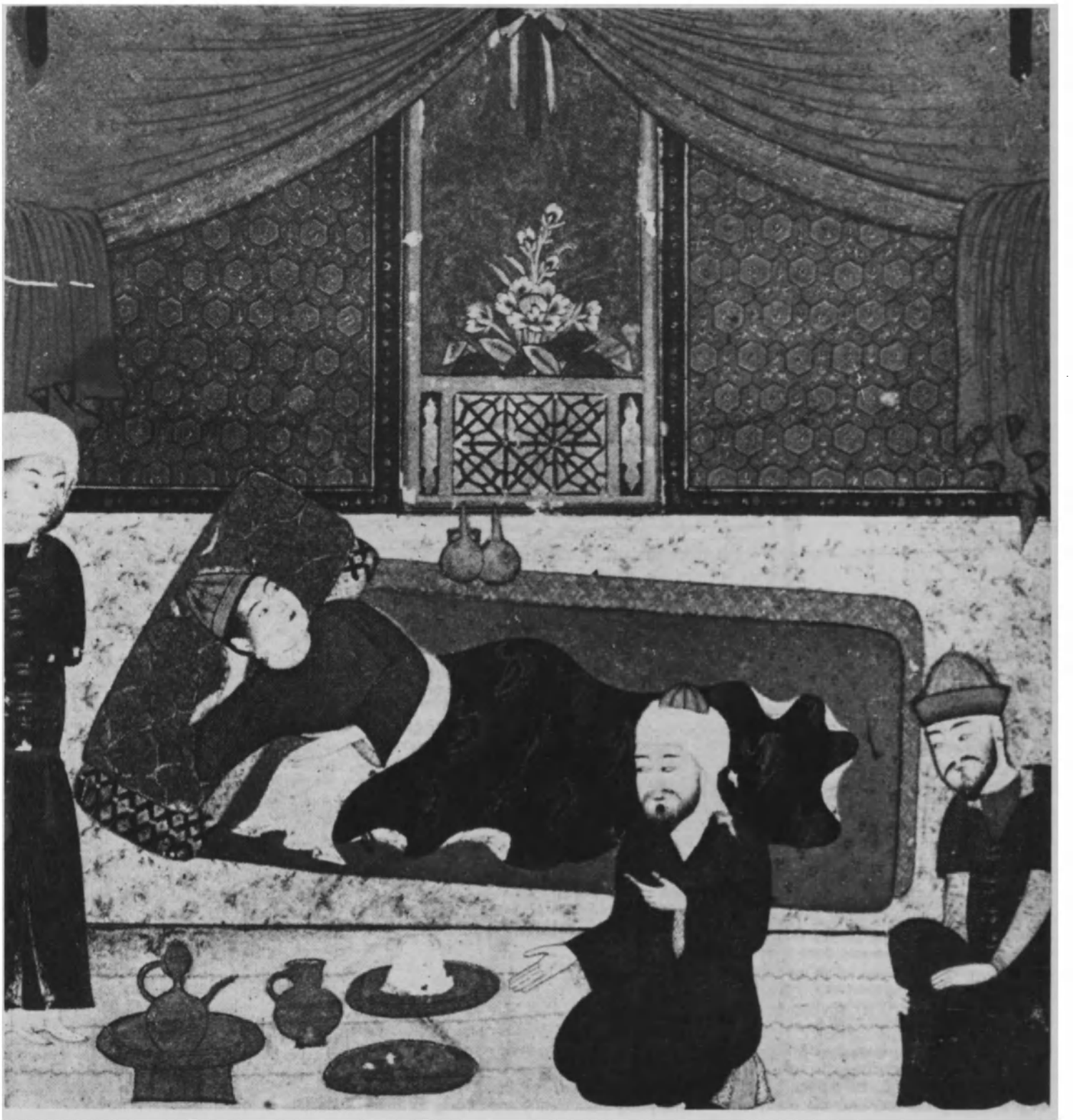
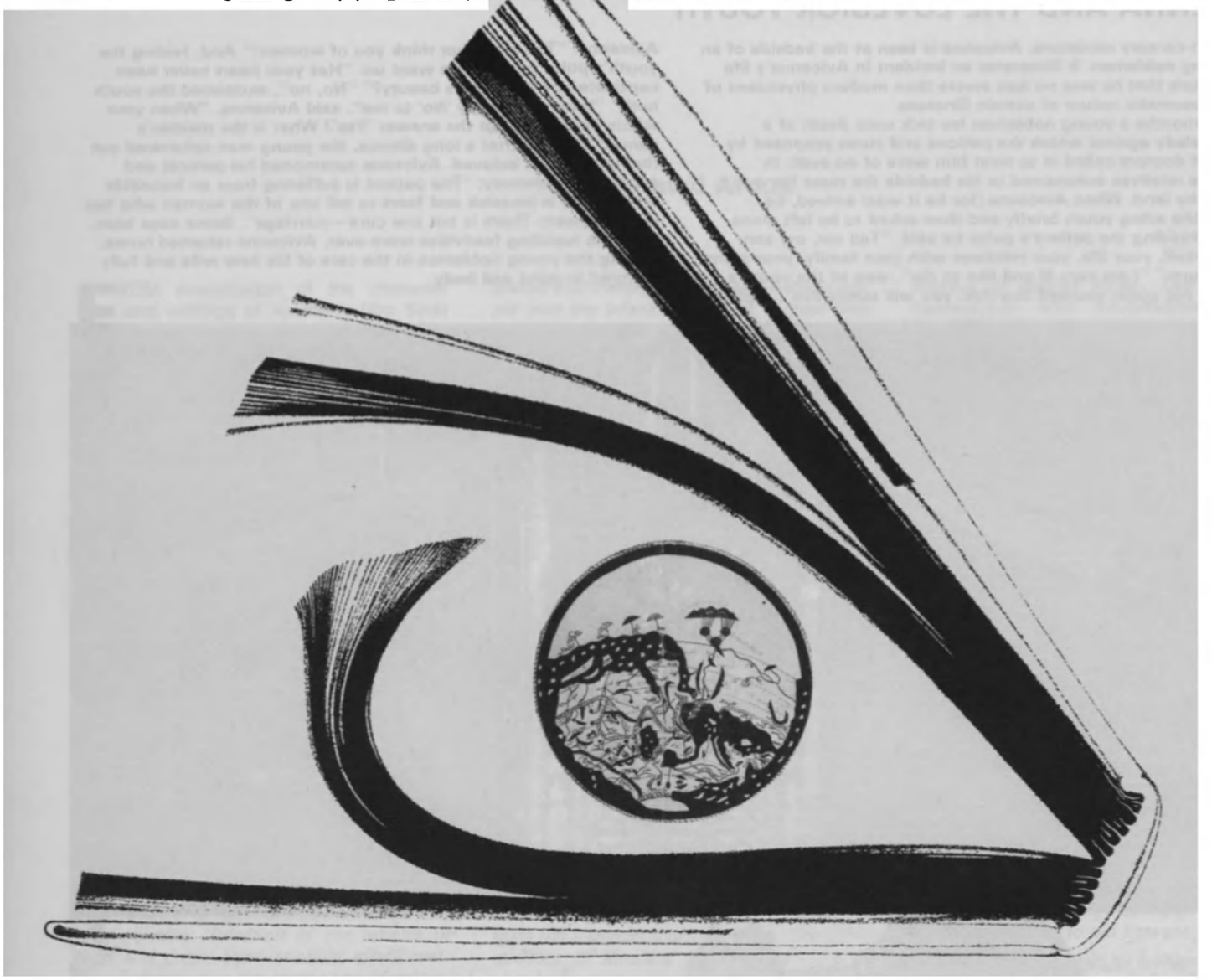


Photo by courtesy of the Wellcome Trustees, London

Al-Shifa: the world in a book



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by Ibrahim Madkur

AVICENNA (Ibn Sina) is rightly considered the most important representative of Muslim philosophy. Al-Kindi and al-Farabi laid the groundwork of this philosophy and established its principles, but it was thanks to Avicenna and his clear expositions that it acquired its final form and distinguished itself from other philosophies.

Today no one can deny that a Muslim philosophy exists. It is neither purely Aristotelian nor purely Platonic. It is a separate philosophy created by special circumstances and by a specific environment. It was influenced by ancient philosophies, borrowing certain elements from them but also incorporating others of its own. It has thus become, in its own right, an independent phase in the development of human thought.

It took up all the important philosophic issues and dealt with them in an original way. It laid great stress on the study of being, analysing the one and the many and defining their interrelations. It delved deeply into the problem of knowledge, distinguishing between soul and intellect, the innate and the acquired, truth and falsehood. It decisively established the theory of virtue and happiness; it created a hierarchy of values and then classified them, thus arriving at the "virtue of virtues"—permanent contemplation—attained by the prophets and other exceptional people. It made a careful study of all the various parts of philosophy, whether speculative or practical—physics, mathematics, metaphysics, ethics, economics and politics—adding to these medicine, biology, chemistry, botany, astronomy and music, all of which were regarded as parts of philosophy in the widest sense.

Assuming this to be the essence of Muslim—i.e. Avicenna's—philosophy, the *Shifa,* is, among all his works, the one which expresses it best. In the *Shifa,* he expounds philosophical problems in detail, analysing them clearly and adding to them certain branches of knowledge considered at the time as an integral part of philosophy. The work introduces ideas deriving from Aristotle, Plato, Plotinus, Zeno and Chrysippus, but presents them in such a way that they form an organic whole. Therein lies Avicenna's originality which appears even more striking when he criticizes and either refutes or defends the views of the Ancients.

Avicenna himself described the object of this great work: "My aim is to include in it all the fruits of the sciences of the Ancients, which I have checked and which are based on outright deduction or induction as ac-

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Photo © Institute of Oriental Studies of the Academy of Sciences of Uzbekistan, Tashkent

Avicenna's *Treatise on Terms* is a dictionary of the principal philosophical notions such as *akl* (reason), *nafs* (the soul), *jawhar* (substance), *makan* (space), and *haraka* (movement). Left, a page from a 14th-century manuscript of the treatise, which is an irreplaceable source for understanding the complex terminology of Medieval Oriental philosophy.

It is difficult to make anyone believe that a person like me is an unbeliever. My faith in God is unshakable. If I am an infidel, then there is not a single true Muslim on earth. *Avicenna*

cepted by thinkers who have long sought the truth. I have tried to incorporate as much as possible of the entire field of philosophy." He adds: "I have omitted nothing that is of any value in the works of the Ancients. If any element is not found in its usual place or context, that is because I have put it in a place which I considered more appropriate."

In fact, the book contains such a wealth of subject-matter that it is quite unique, and unlike any other work of philosophy. It is divided into four major "Summae" (*jumal*): Logic, Physics, Mathematics and Metaphysics. Each "Summa" in turn is divided into books (*funun*), each book into sections (*magala*) and each section into chapters (*fusul*). This is the general plan of the work, but within each division and subdivision there are various subordinate sciences and objects of study.

The *Shifa* is in fact an encyclopaedia in which all the rational sciences have been gathered together, predating our modern encyclopaedias by six centuries. The modern works, of course, deal with very many more subjects, but the *Shifa* does cover the whole range of the rational sciences as they existed at the time. The most surprising thing of all is that it is the work of one man, whereas modern encyclopaedias, from Diderot onwards, have been produced by large teams of contributors.

Though its author lacked the peace and quiet necessary for a work of such

God is the depth and the surface. He is manifest everywhere and in all things. *Avicenna*

magnitude, he succeeded in producing a remarkably well-ordered and logically set-out book. The work, begun in Hamadhan, was completed in Isfahan within a span of about ten years. Ibn Sina was forty and in his intellectual prime when he started the *Shifa*. By the time he finished it he was already past fifty.

Thus the *Shifa* is not, as was long thought, a commentary on Aristotle, like those of Averroës or St. Thomas Aquinas. Avicenna included in it the results of his own wide-ranging research and theorizing, accepting certain views and rejecting others. Sometimes he borrows ideas from other authors and discusses them, but without mentioning their names or quoting his sources.

The best description of the book is to be found in the author's own introduction: "This book," he writes, "ultimately presents all the ideas unanimously accepted by practically every thinker. Instead of indulging in personal prejudice, I have done my best to include in it the greater part of philosophy, raising objections on each point, then attempting to disprove them, and showing the truth as far as possible. I have taken care to mention the main principles together with their corollaries, leaving out, however, anything that seemed to me to be clear from what had gone before—or anything that happened to slip my memory."

This introduction does not seem to have been available to the Christian thinkers of the Middle Ages or, if it was, it escaped their attention. In any case they did not study the *Shifa* in sufficient detail to realize that it was not a mere commentary or gloss on Aristotle, but an original work in its own right.

Avicenna made the best use of the wealth of knowledge available in his time. If one book can be said to reflect the period in which it was written, the *Shifa* is undoubtedly the best source of information on the intellectual life of the fourth century of the Hegira.

Scholars who have studied this period rightly consider it to be the Golden Age of rational studies in Islam. A school (the *Kalam*) for interpreting the Koran was set up under Ash'ari, and its activities were regarded as constituting a branch of science. Mysticism was also following new paths: it went beyond asceticism and hermitism and embarked on the explanation of states of the soul; it analysed minutely the stages of "initiation"; it claimed to attain union with God. Muslim philosophy was laying down its foundations and establishing its principles: al-Farabi, a profound and penetrating thinker, organized its various parts.

Islamic medicine reached its zenith with the work of the great physician al-Razi (Rhazes), and no longer confined itself to repeating the dicta of Hippocrates and Galen: al-Razi actually made use of his own experience. And mathematics and astronomy were making great strides: one need only mention here the name of al-Biruni from among a phalanx of renowned scholars and scientists.

It is generally true to say that while in the second and third centuries of the Hegira Islamic scholars concentrated mainly on translating and assimilating foreign sciences, in the fourth century they launched into research in their own right, moving from assimilation to original creation.

Usually a book's influence is restricted to that of its author and it belongs only within the range of that author's work. But there are some books which are special and have a history and influence of their own. Avicenna's philosophy was the philosophy of the whole Arab world from the fifth century to the beginning of the fourteenth century of the Hegira: all authors, philosophers,

If I had made no impact on men's hearts, they would have ignored me. They would have been neither for me nor against me. *Avicenna*

theologians and mystics, of all schools of thought, drew upon it. During this time, even scientific studies in medicine, biology, astronomy and mathematics used it as a base. Avicenna is the Philosopher of Islam, par excellence.

It is true that al-Ghazali's attack on philosophy and the "falasifa" [philosophers] turned many scholars away from Avicenna. But this did not put an end to his influence. It can be said that such philosophy as survived in Islamic culture certainly owes its existence to him. The Spanish school of philosophy which developed later never

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The unifying perspective of Islamic science, in which all forms of knowledge are interdependent, found brilliant expression in Avicenna with his encyclopaedic mind, voracious appetite for learning, and determination to organize his thought in a logical, systematic way. One of his accomplishments in the natural sciences was in mineralogy where his descriptions and classification of metals and minerals and his theories on their origins became a major source of geological knowledge in the Islamic world as well as in Christian Europe until the Renaissance. Above left, an illustration from an 18th-century Persian manuscript on mineralogy. Muslim ophthalmologists in Avicenna's time were leaders in their field and their knowledge was transmitted both westwards into Europe and eastwards into India. Avicenna's own highly influential treatise on the subject not only discusses the anatomy of the eye and the principles of vision but gives his readers practical, down-to-earth tips on how to prevent their sight from failing. Above right, detail from a sixteenth-century ophthalmological treatise now in the library of Istanbul University. Below, decorative brickwork in the Friday mosque at Kerman, Iran, shows how geometry can be used in Islamic art and architecture to express the cherished idea which presides over Avicenna's towering achievements as a thinker: the emanation of Multiplicity from Unity and the return of Multiplicity to Unity—the Presence of the One in the Many.

Photos Roland Michaud © Rapho, Paris
Photo © Roland Michaud, Paris

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Above, twelfth-century map showing North Africa and Europe as envisioned by the great Moroccan cartographer al-Idrisi at a time when the influence of Avicenna's ideas was spreading throughout the Islamic world and Christendom. According to a convention which is unique to Arab-Islamic cartography, the south is at the top of the map. Below, fifteenth-century miniature showing the French surgeon Guy de Chauliac (1300-1368) receiving his patients. One of the most learned men of his time, Chauliac studied at Montpellier University, where Avicenna's theories were the cornerstone of the medical syllabus from the 12th to the 16th century. Chauliac was an ardent defender of Avicenna's ideas and in his writings cited the Master over 600 times.

Photo © Jean-Loup Charmet, Bibliothèque Nationale, Paris

فلما فرغ بياض من شعره قالت له رياض الله حسيب من غدر وهجر
ولم ينصف مع امكان الوصل ووجود السبيل فقال بياض أقل الوفا قليل
ثم قالت السيدة يا بياض أنت شاعر عاقل وأديب أريب ونحن نقول ما
روينا وحفظنا وسمعنا من غيرنا وأنت تقول من تلقاء نفسك بارك الله
فيك ووقاك المحذور وتلقاك بالخير والسرور فنحن الكل نعبوا الليل ومفرحون

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In the *Shifa* and other works Avicenna went deeply into the theory of music, which he defined as "a mathematical science in which there is discussed the state of melody insofar as it is in harmony or in discord and the state of the intervening periods". According to a tradition going back to Pythagorean times music was considered as an integral part of science, and as George Sarton writes in his *Introduction to the History of Science*, "music could be more easily transmitted by popular contact than almost any other activity, and practical music would be followed, sooner or later, by theoretical music. Thus did it come to pass that Muslim science penetrated Christendom at least partly upon the wings of music." This very rare illuminated manuscript was produced in Spain or Morocco in the early 13th century. It shows a scene from the story of Bayad and Riyad in which the lover Bayad sings of his woes to a noble lady and her attendants.

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This detail from a 17th-century Persian manuscript in the Islamic Museum, Cairo, shows a figure purported to be Avicenna teaching a group of students. In addition to the astonishing gifts and scintillating mind which fascinated his contemporaries Avicenna also seems to have possessed striking good looks and an impressive figure. A description of him attending court at Isfahan in the closing years of his life relates how, wearing a long robe and a turban of coarse cloth, "he used to sit very close to the Amir, whose face became radiant with delight as he marvelled at his good looks and accomplishment and wit. And when he spoke all those present listened attentively, none uttering a word."

SONG OF THE SOUL

It descended upon thee from out of the regions above,
That exalted, ineffable, glorious, heavenly Dove.
'Twas concealed from the eyes of all those who its nature would ken,
Yet it wears not a veil, and is ever apparent to men.
Unwilling it sought thee and joined thee, and yet, though it grieve,
It is like to be still more unwilling thy body to leave.
It resisted and struggled, and would not be taméd in haste,
Yet it joined thee, and slowly grew used to this desolate waste.
It weeps, when it thinks of its home and the peace it possessed,
With tears welling forth from its eyes without pausing or rest,
And with plaintive mourning it broodeth like one bereft
O'er such trace of its home as the fourfold winds have left.
Thick nets detain it, and strong is the cage whereby
It is held from seeking the lofty and spacious sky.
Until, when the hour of its homeward flight draws near,
And 'tis time for it to return to its ampler sphere,
It carols with joy, for the veil is raised, and it spies
Such things as cannot be witnessed by waking eyes.
On a lofty height doth it warble its songs of praise.
(For even the lowliest being doth knowledge raise.)
Now why from its perch on high was it cast like this
To the lowest Nadir's gloomy and drear abyss?
Was it God who cast it forth for some purpose wise,
Concealed from the keenest seeker's inquiring eyes?
Then is its descent a discipline wise but stern,
That the things that it hath not heard it thus may learn.

(Extract from one of Avicenna's most famous poems.
Translation Professor E.G. Browne)

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lessened Avicenna's prestige in the East despite the relatively large number and importance of its representatives, in particular the prolific Averroës. The fate of this school was linked to that of Spain itself and it is not surprising that Averroës' influence should have been stronger in the Latin West than in the East.

Avicenna's books continued to be studied after his death. The *Najat* and *Isharat* were particularly popular, but the *Shifa* retained its attraction: it contains many details not to be found in the two other works, and scholars wishing to go more deeply into their subject found they needed to refer to its lengthy explanations. When, for example, al-Ghazali, in the *Tahafot al-Falasifa,* and Shahrastani, in the *Nihayat al-Iqdam,* discuss in some detail the creation of the world and the impossibility of its eternity, the ideas they attribute to Ibn Sina were borrowed mainly from the *Shifa*.

Ibn Rushd (Averroës) often quotes extracts from the *Shifa* either to support his own theories or to contradict Avicenna, mentioning his name on each occasion. Nasir al-Din al-Tusi was one of Avicenna's faithful disciples in spite of the fact that he lived two hundred years later: his attitude towards Fakhr al-Din al-Razi and the fight he waged against him are well known. Similarly Ibn Khaldun recognized the importance of the *Shifa* which he mentions several times in his *Prolegomena*.

Three treatises have dominated Muslim theological studies in the last few centuries: *al-Aqa'id* by Nasafi, Iji's *Mawaqif* and the *Maqasid* of Taftazani. If we examine their content and the commentaries that have been written on them, we can see that they made extensive use of the *Shifa*.

In Logic, the general tendency of scholars to be as succinct as possible led to works such as Abhari's *Isagoge,* Qazwini's *Shamsiyya* and Akhadari's *Sullam* which have dominated the teaching of Logic in the Islamic world for the last six hundred years. One book, however, published during this period, the *Basa'ir al-nasiriyya,* recalls the breadth and clarity of the *Shifa's* logic. Its author states that he has drawn some of his ideas from Ibn Sina, whom he describes as the "best of the moderns".

Few works, at any period, have exercised a greater influence than the *Shifa* on human thought. In this, Avicenna's masterwork, the duality of his personality is revealed: received influence and personal reaction, assimilation and original contribution.

■ **Ibrahim Madkur**

A champion of the rationalist and scientific spirit, Avicenna relentlessly attacked the obscurantist ideas of his time. To support his rejection of alchemy he used philosophical as well as scientific arguments to show that the then widely held belief in the transmutation of metals was untenable. Illustration is taken from an Arabic version, produced in 13th-century Baghdad, of the *Materia Medica* written by the Greek physician Dioscorides in the Ist century AD.

A philosopher under fire

Avicenna's doctrines stirred up controversy in his own time and later

by Reza Davari

THE philosophical works of Avicenna (Ibn Sina) were violently criticized both during his own lifetime and after his death. Two major accusations were levelled against him: atheism and heresy on the one hand and a lack of originality on the other.

Some of his opponents stressed contradictions between his thought and the teachings of the Koran, while others regarded him as a mere compiler. And one gathers from Avicenna's own writings that at a certain period of his life he was ostracized because of his ideas.

Among his most disparaging critics were the theologian and philosopher Fakhr al-Din al-Razi (1149 or 1150-1209) and the philosopher al-Ghazali (1058-1111) also known as Algazel. But the strongest attacks came from contemporary theologians.

In modern times, a few scholars have challenged the originality of Avicenna's work. Some have compared it to that of Ferdowsi (c. 930-1020) and al-Biruni (973-1048) in astronomy and the natural sciences, and of al-Razi (c. 865-923) in medicine, concluding in each case that Avicenna's contribution was inferior. Other critics even maintained that as a philosopher Avicenna had merely revived and expanded on the ideas of his illustrious predecessor al-Farabi without making any substantial contribution of his own.

The first question one may therefore ask is whether Avicenna was an innovator in philosophy or a mere compiler. Al-Farabi (872-950) was undoubtedly the founder of Islamic philosophy. But his general views mainly reflect fundamental principles prevailing during the first centuries of the Islamic era. It is therefore likely that if al-Farabi had not existed, Avicenna would have reached the same conclusions. For ideas are not generated spontaneously by men; men are dependent upon the ways of thinking of their time.

In fact, the originality of al-Farabi himself has been the subject of long controversies.

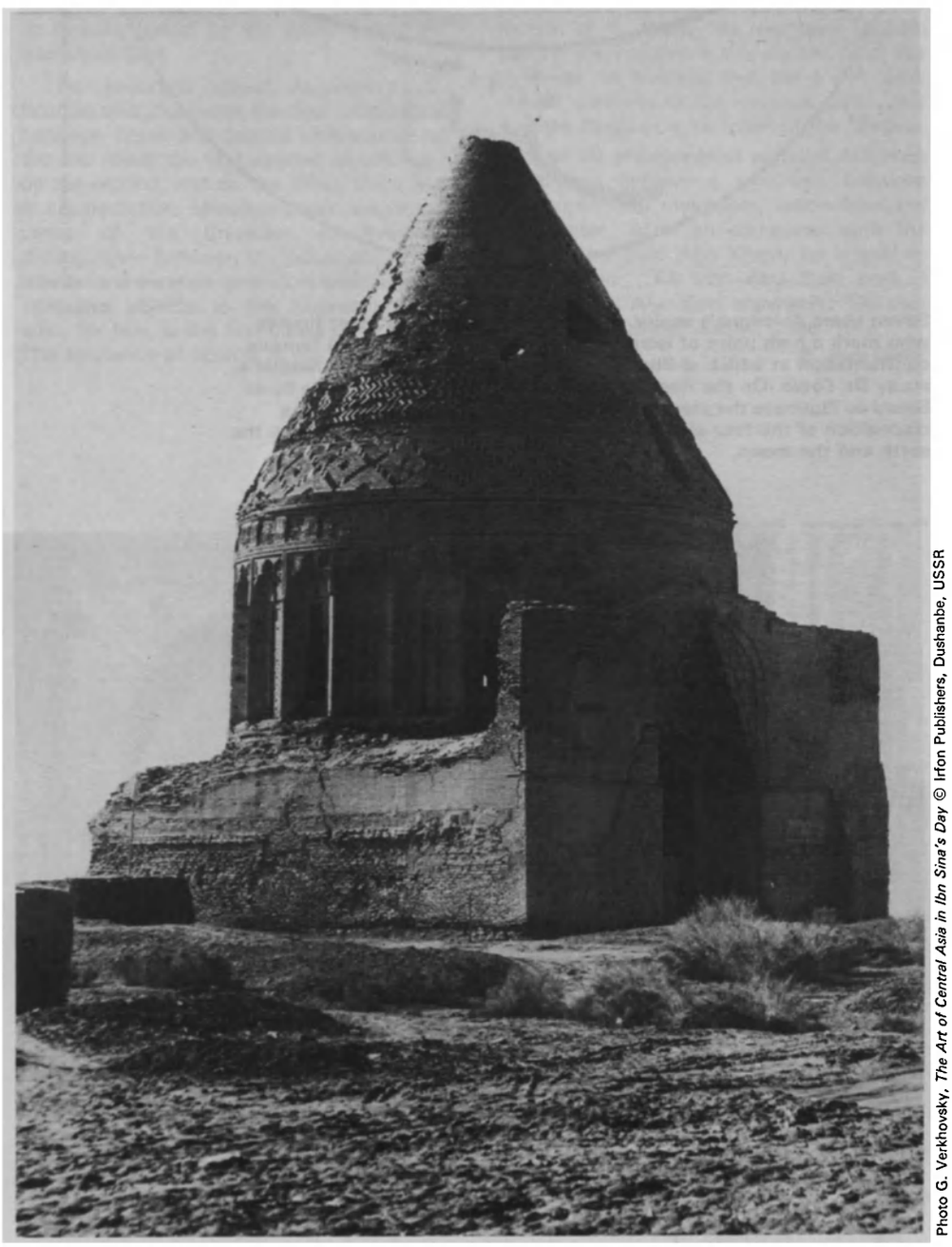

Photo G. Verkhovsky, *The Art of Central Asia in Ibn Sina's Day* © Irfon Publishers, Dushanbe, USSR

Built at Gurganj by the ruler of Khorezm, the Khorezm-Shah Tekish, who came to power towards the end of the 12th century AD, this mausoleum is one of the rare buildings to have survived that troubled period. Avicenna's stay at Gurganj was short but pleasant. He was befriended by the vizier Abu-l Husayn as-Soheili and joined the circle of brilliant scholars, which included the famous al-Biruni, at the court of the Emir of Gurganj.

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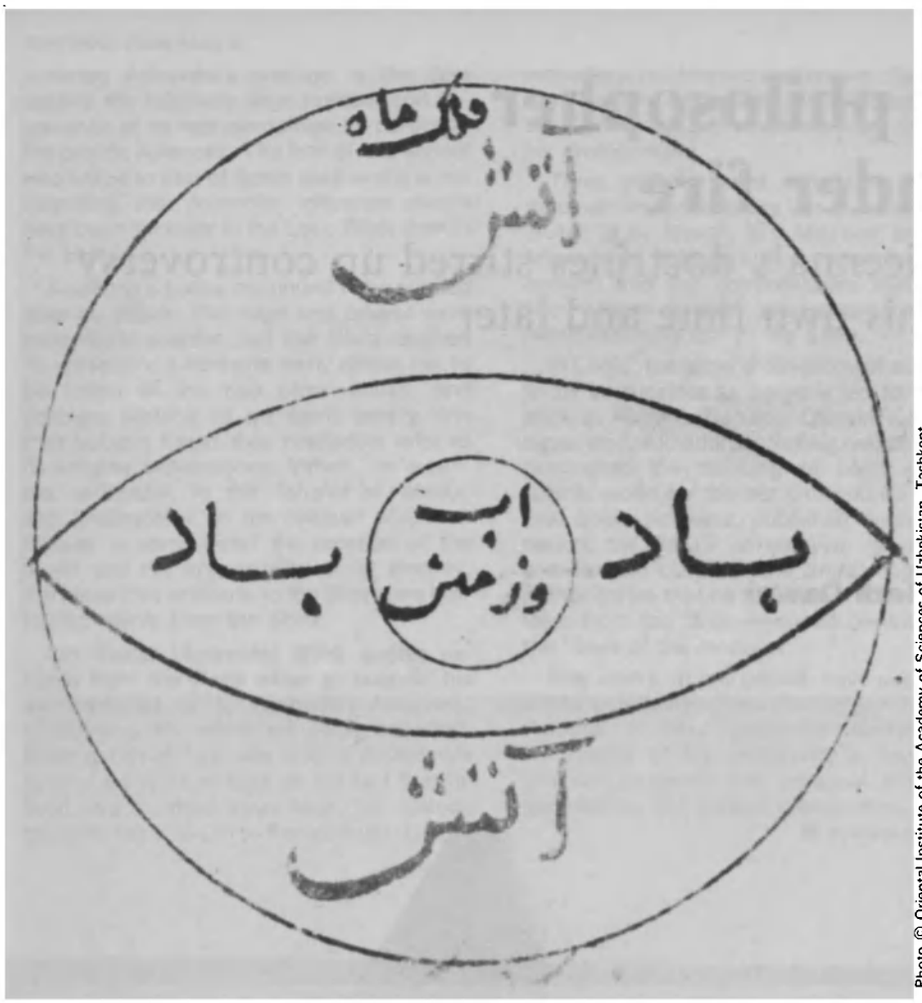

Photo © Oriental Institute of the Academy of Sciences of Uzbekistan, Tashkent

Seven years Avicenna's senior, al-Biruni was one of the great figures who mark a high point of Islamic culture. The two men had a famous confrontation at which al-Biruni questioned Avicenna about Aristotle's study *De Caelo* (On the Heavens). The drawing above was made by al-Biruni to illustrate the view expressed by Avicenna concerning the disposition of the four elements (earth, air, fire and water) between the earth and the moon.

Avicenna and al-Farabi (872-950) were not only great philosophers they both made valuable contributions to the advancement of the theory of music. Al-Farabi's *Grand Book of Music* has been the subject of a modern study and Avicenna devoted the last chapter of his *Book of Healing* to music. Both men gave descriptions of the *tambura,* a lute-like musical instrument popular in their day. Left, a Tadzhik, four-string *tambura* in mulberry wood, made at the beginning of this century and modelled on the ancient instruments of Khorasan.

Photo © Academy of Sciences of the Tadzhik SSR, Dushanbe

Photo © Anderson - Giraudon, Paris

Left, detail from the *School of Athens,* one of four frescoes painted by the great Italian artist Raphael in the *Stanza della Segnatura,* in the papal apartments of the Vatican. In the centre can be seen Aristotle and Plato, two towering figures of the Athenian school of philosophy, by whom Avicenna was profoundly influenced.

Averroës (Ibn Rushd), Ibn Khaldun and their contemporaries accused him, as they accused Avicenna, of amalgamating philosophy and religion. But here criticism comes from two diametrically opposed camps. While al-Ghazali and Fakhr al-Din al-Razi stigmatize the philosophers for views which they consider incompatible with religious teaching, and go as far as to label them heretics, Averroës and Ibn Khaldun regard philosophy and religion as two separate paths both leading to the same goal.

Al-Farabi and Avicenna were convinced, however, that their ideas were in line with religious thought. They conceived true religion as a philosophy and maintained that philosophy was the heart of religion. Like al-Farabi, Avicenna used philosophy to interpret certain verses of the Koran. He considered philosophy central to Sufism, an idea which he discusses at length in the final chapter of his work *Isharat wa Tanbihat.*

During the nineteenth century, Shi'ite thinkers and scholars in Iran revived the idea of the separateness of religion and philosophy, which Averroës had so passionately defended. But, whereas Averroës gave pride of place to philosophy, the Iranian scholars' main concern was to defend religion. "Greek philosophy... but for how long?" they asked, echoing the Bahai Sheikh. "Study also the philosophy of the believers."

To sum up, what some consider a heresy and others a mixture of Greek ideals and the fundamentals of religion forms the very essence of Islamic philosophy. But this philosophy is far from being a mere copy of Greek thought, though it has certainly drawn inspiration from it. If Averroës, for example, had confined himself to interpreting Aristotle, his name would never have been remembered in the history of human thought.

An anecdote related by Avicenna himself illustrates this point. Avicenna read Aristotle's *Metaphysics* forty times, but it was only with the aid of al-Farabi's commentary on the *Metaphysics,* the *De Interpretatione,* that he finally succeeded in overcoming the difficulties he found in the text. Al-Farabi's true merit, according to Avicenna, was that he started the process of incorporating Greek philosophy into the Muslim view of the world. Al-Farabi served as a link between Aristotle and Avicenna by drawing together the ideas of the first and the value system of the second.

We lack detailed information about the subjects which made it hard for Avicenna to understand the *Metaphysics,* and therefore cannot give precise opinions on the matter. It is very likely, however, that his main difficulty lay in commenting on Aristotle's key ideas, in the context of a philosophy fundamentally based on the belief in the existence of God.

This anecdote about Avicenna's difficulties also illustrates the dual relationship between Greek and Islamic philosophy: on the one hand, the first exerted an influence on the second, and on the other, there was a contradiction between their respective views of the universe. If Avicenna distinguishes between the possibility of existence and essence (entity), it is because he attributes objects to the Supreme Being who, for him, is the first cause of all being. The existence of objects is not the same as Aristotle's God seen as final cause and pure thought. But it represents science, will, power and life... The Supreme Being is the vital force in all beings. Everything that exists or will exist is part of His knowledge.

Since these differences in attitude on existence and the meaning of causality led to the creation of new schools of philosophy, it is clear that Avicenna's philosophy and that of the Ancient Greeks differed not merely in detail, but rather on fundamental principles.

Before Avicenna, al-Farabi had rated revelation and prophecy with wisdom. He had come to the conclusion that a prophet attains active wisdom through thought and that revelation is to be found in the association of active wisdom and thought.

Avicenna more or less agrees with al-Farabi except that, for him, prophecy and the message rank above all else in the perfection of man. When he finds himself unable to expound a religious topic, he admits his own imperfection and falls back on interpretation of the Koran or the Prophet. Since he is incapable of explaining the resurrection of the body, he maintains that he follows the Prophet in this matter. And, like al-Farabi, he believes that the social order should conform to the religious order, and that the Prophet is the chief of the Medina.

In all his philosophical writings Avicenna sought to achieve a synthesis between philosophy and mysticism, rationalism and spiritualism. After an encounter with the mystic Abu Said Abu Khevi, he is said to have stated: "All that Abu Said sees, I know." And Abu Said answered: "All that Abu Ali (Avicenna) knows, I see."

■ **Reza Davari**

Photo Aleksei Zhdanov © Oriental Institute of the Academy of Sciences of Uzbekistan, Tashkent

The Persian poet Ferdowsi (930-1020 AD) was another of the great contemporaries of Avicenna, who was an avid reader of Ferdowsi's epic masterpiece the *Shah-Nama* or *Book of Kings.* Left, illustration dating from 1556 AD by the artist Mohammed Murad Samarkandi for an episode in the *Shah-Nama,* the "Marriage of the Son of Feridun". Avicenna was also an accomplished poet, but some of his detractors, somewhat unfairly, drew unfavourable comparisons between his poetry and that of Ferdowsi.

How Ibn Sina became Avicenna

Transmitted to Europe, his writings sparked off an intellectual revival

by Salvador Gómez Nogales

IT would be inconceivable to celebrate the thousandth anniversary of Avicenna's birth (in the Christian calendar) without examining the debt Westerners owe to this great Oriental genius.

The influence of Avicenna in the West was immense, giving birth to an intellectual movement, "Latin Avicennism", which bore his name. This influence made itself felt in three major areas: philosophy, the sciences (especially medicine), and literature.

In philosophy, Avicenna dealt with all the branches of Aristotelian enquiry: logic, physics and psychology, metaphysics, ethics, economics and politics, philosophy and religion. He was also one of the great theorists of mysticism.

In the sciences he influenced posterity in almost every field in which he worked. From medicine, mathematics, astronomy, alchemy and astrology, to geology and geography, mineralogy, herbalism, zoology and the natural sciences, there is hardly an area into which he ventured without whetting the curiosity of later scientists.

Avicenna's artistic sensitivity can be felt in his scientific and philosophical works, above all in his mystic treatises. He also authored several didactic poems on logic and medicine which found an echo in the work of later thinkers, including men of such stature as the Cordoban philosopher and scientist Averroës (Ibn Rushd) (1126-1198).

Another accomplishment of Avicenna the artist and humanist was in music, where his writings would leave a mark on the work of later theoreticians.

As for his influence in the Arab-speaking West, that is Muslim Spain or *al-Andalus* (Andalusia), it has to be admitted that Andalusian thinkers, with very few exceptions and for reasons that remain obscure, were initially extemely hostile to Avicenna.

We do not know exactly when Avicenna's thought reached Muslim Andalusia, but the first person to be acquainted with it there was the great Spanish thinker Ibn Hazm, who died in 1064 AD, and was more or less a contemporary of Avicenna. Ibn Hazm never travelled to the East, but according to the modern Spanish historian Asin Palacios, he studied the works of Oriental writers in the libraries of Andalusia.

But convincing evidence of Avicenna's direct influence in Muslim Andalusia does not appear until the twelfth century with Ibn Tufayl (d. 1185) whose familiarity with the great thinker's work suggests that Avicenna was by then known to Andalusian scholars.

Ibn Tufayl knew that Avicenna's *Shifa* (Book of Healing) was remarkable for its commentary on the works of Aristotle, and that Avicenna had written another original work (*The Philosophy of the Easterners*) in the tradition of the Neo-Platonists, in which he parted company with Aristotle. He was also aware that not everything in the *Shifa* originated with Aristotle. This is an important detail, not only because of the familiarity with Avicenna's work which it presupposes but because it explains why Averroës would later show hostility to Avicenna.

Ibn Tufayl was also familiar with Avicenna's treatises on mysticism, and it was in furtherance of this non-Aristotelian, esoteric aspect of the philosopher's work that Ibn Tufayl wrote the philosophical novel on which his reputation rests, *The Self-Taught Philosopher*. Both the novel's Arabic title, *Hayy ibn Yaqzan*, and its two main characters, Absal and Salaman, are taken from Avicenna.

And so the evidence tends to show that Andalusians were familiar with Avicenna's works by the middle of the twelfth century.

The relations between Avicenna and Averroës fall into a category of their own. Divergences between the two far outnumber the points on which they agree, and Averroës fiercely attacks Avicenna at every possible opportunity.

There were two main reasons for Averroës's aversion. The first of them, then relatively common among Islamic philosophers, was the hostility he felt towards the *Mutakallimun* (theologians who philosophized about the articles of the Islamic faith) from whom, according to Averroës, Avicenna derived some of the proofs which made him break with Aristotle.

The second reason, which may have irritated Averroës even more because it seemed to be more fundamental, was that by blending certain Neo-Platonist and Aristotelian theses Avicenna had adulterated Aristotelianism. Perhaps the most flagrant example of this is Avicenna's espousal of the Neo-Platonist principle that the One can proceed only out of the One.

When Averroës, concurring with the Islamic theologian and philosopher Al-Ghazali (1058-1111), refutes Avicenna's proofs, the arguments he uses to defend philosophy are simple: Avicenna's proofs are not those of Aristotle, nor do they derive from any of the classical philosophers. Hence it is Avicenna who is at fault and not philosophy, as Al-Ghazali had argued. Thus the thread running through Averroës's philosophy, insofar as it constitutes a reply to Avicenna, is a return to pure Aristotelianism, eschewing the mystical adulterations which had been introduced by Al-Farabi (872-950) and by Avicenna himself.

But in one field—medicine—Averroës does accept Avicenna's superiority, and his admiration is evident in his commentaries. For just as Averroës is recognized as Avicenna's equal or superior in philosophy, in

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Between the 8th and the 15th century an Arab civilization took shape on the Iberian peninsula which had a far-reaching influence, above all in the Christian West. At times the confines of Muslim Spain (*al-Andalus* as it was known in Arabic) stretched over the greater part of the peninsula. For much of the period Córdoba was the main centre of this blossoming culture: it grew to be the biggest city in the West, with a population of 250,000; it boasted a university, a magnificent mosque (right, the ceiling of the antechamber to the *mihrab*, the room indicating the direction of Mecca); its cultural and commercial life was intensely active. It was the birthplace of great writers and philosophers such as Ibn Tufayl, Averroës and Maimonides, who transmitted to Europe the learning which reached them from the Orient, including the scientific and philosophical writings of Avicenna. Apart from the Great Mosque of Córdoba, *al-Andalus* produced other famous monuments such as the Alhambra of Granada, the Giralda and Alcázar of Seville, and the Aljafería palace at Saragossa. Their influence on the Christian architecture of the Iberian peninsula and beyond was striking, and can be seen (below) in these arches in the cloister of San Juan de Duero, at Soria. Below left, 10th to 11th-century Persian ceramic with Kufic inscription.

Photo Jean Mazenod, *L'Islam et l'Art Musulman*, © Editions d'Art Lucien Mazenod, Paris

Photo © Mas, Barcelona

medicine it is acknowledged that Avicenna outranks him and that Avicenna's influence on posterity was far greater.

By the second half of the twelfth century, Avicenna's intellectual citizenship was so well established in Muslim Andalusia that it began to alarm the religious authorities. This concern is reflected in the couplets of the Valencian Ibn Yubayr (1145-1217), who complained of the emergence of a sect whose intellectual leaders were Al-Farabi and Avicenna. Ibn Yubayr claimed that this sect was exlusively concerned with inanities and substituted the false wisdom of philosophy for the true wisdom of religion.

As for Avicenna's mystic doctrines, they reached Muslim Spain indirectly, through the work of Oriental mystics such as al-Ghazali and Suhrawardi, who were influenced by him. But it has been established that his mystical works were read also at first hand by the Spanish Arabic-speaking philosophers as well as by the mystics such as Ibn Arabi of Murcia.

This is the point at which to trace the spread of Avicenna's work through the Latin West, noting especially how Spain acted as a bridge in this process.

During the twelfth and thirteenth centuries, Spaniards produced many translations from Arabic into Latin, and these were republished on a large scale during the fifteenth and sixteenth centuries. European humanists and scientists formed such a high opinion of the achievements of Arabic science in Spain that many of them unhesitatingly classified as Spaniards certain Oriental thinkers such as Avicenna, who had never set foot on Spanish soil.

The modern historian of science George Sarton considers Muslim Spain to be the most important cultural centre of the Middle Ages. Indeed, fifteenth century Europeans were so dazzled by Andalusian culture that many of them believed that the brilliance came from Spain and not from the Orient. This widespread error was not new: the thirteenth-century Spanish bishop and chronicler Lucas de Tuy, for example, believed that Aristotle himself was Spanish. Many thought that all the names in the Latin translations were Spanish, and the Italians of that time transformed Avicenna into a Cordoban. It is interesting to note that the great thinker's name, Ibn Sina in Arabic, was immortalized in the West in the form which it assumed in Muslim Andalusia.

The interest which the Arabs, and more specifically Avicenna, aroused in the West can be gauged from this flow of translations. Specialists have underscored the major contribution of Spain to the translation movement, often referring to the School of Toledo. But important though it was, Toledo was not alone in producing the massive spate of translations. Translators from all over the Iberian peninsula, working alone or in groups, inundated the Western world with Latin and Hebrew versions of Arab texts.

Spain was thus the main conduit through which Avicenna's work flowed into Europe, at a moment, moreover, when his ideas came as a windfall for medieval philosophy. Scholasticism—the system of Western Christian philosophy that flourished from the eleventh to the fifteenth century—owed its renewal to two movements in whose formation Avicenna was a key figure: the transformation of Aristotelianism into a buttress of religious thought, and the revival of Augustinianism through direct contact with Greek and Iranian Neo-Platonism.

All medieval European philosophers were acquainted with Avicenna's work: they either accepted his teachings or were engaged in refuting them. And even those who attempted to refute him assimilated at least some of the values which imbued his writings.

Photo © Giraudon, Bibliothèque Nationale, Paris

Detail from a 13th-century engraving showing the great Cordoban philosopher and physician Averroës conversing with Porphyry. Averroës contested many of Avicenna's philosophical ideas and took issue with him on the respective value of philosophy and religion. Nonetheless his contribution to the diffusion of Avicenna's work in the West was considerable.

Right, cover of an Arabic edition of Avicenna's *Canon of Medicine* published in Rome in 1593. The *Canon* was one of the first books to be printed and published after Gutenberg' s invention of movable type.

Medieval authors not only drew on him, they made him one of the great authorities for their doctrines, probably invoking his name more often than that of any other thinker except for St. Augustine, Aristotle, Boethius and St. John of Damascus. So preponderant did his influence become that without him medieval philosophy would undoubtedly have taken quite a different turn.

Very few of Aristotle's works were known in the Latin West when the translations of Avicenna began to pour into Europe. The translations provided three things: a far more complete understanding of Aristotle than Christendom then possessed; a commentary on Aristotle's principal works; and a philosophic codification of Aristotelian problematics which offered a synthesis of philosophy and religion.

The Arabs, and particularly Avicenna, directly influenced Scholasticism not as a variant of Greek Aristotelianism but by providing original new perspectives. They exercised their influence not only on heterodox philosophers but on the orthodox outlook of the great Christian thinkers. So powerful was their impact that the English theologian and philosopher Roger Bacon (1214-1294) could present Avicenna as one of the line of the great prophets.

The Aristotelian aspects of Avicenna's influence are felt most strongly in Thomism (the philosophico-theological system of St. Thomas Aquinas [1225-1274]), in the thought of the British theologian Duns Scotus (1265-1308), and later in the work of the sixteenth-century Spanish theologian Francisco Suárez. This influence found its way into the Dominican school through the first original metaphysical synthesis of Thomas of York (d. 1260). But Avicenna's presence is most notable in the work of the two main Dominican architects of Thomism, St. Albertus Magnus (c. 1200-1280) and St. Thomas Aquinas, and in that of their great commentators, Tommaso de Vio, Cardinal Cajetan (1468-1534) and John of St. Thomas (1589-1644). In opposition to Thomism is the Aristotelianism of the Franciscan school, under the aegis of Duns Scotus. It is interesting to note how both Thomas Aquinas and Duns Scotus support opposing doctrines by citing Avicenna.

But it is mainly in the Augustinian tradition that a Latin Avicennism comes to light. All of Avicenna's illuminative wisdom blends perfectly with Augustinianism, giving it a badly needed systematic framework.

Avicenna's influence on philosophy is by no means confined to the Middle Ages. To the extent that medieval Christian thought has a place in modern philosophy and theology, Avicennism still occupies the place assigned to it by history.

There are two areas in which Avicenna's thought still carries weight. First, his influence is notable in modern subjectivism, from Descartes to Kant. It is equally evident in all the ontological proofs for the existence of God, from Henry of Ghent to our own times. Finally, in formal logic Avicenna was eight centuries ahead of the West. It was not until the Renaissance that arguments set forth by Avicenna reappear.

This brings us to the second area in which Avicenna influenced the West, namely that of the sciences.

When Westerners look to Spain in search of the splendours of Islamic culture, they are actually looking for the "new science" of the Arabs, which Avicenna undoubtedly personifies. He was deeply interested in mathematics, but as a philosopher rather than as a technician, in the manner of a late Neo-Platonist. He also produced many works on astronomy and astronomical observations. His astronomic teachings, along with those of Averroës, were expounded at the Universities of Bologna, Padua and Ferrara.

CONTINUED PAGE 38

كتب القانون في الطب

لابو علي الشيخ الرئيس

ابن سينا

مع بعض تاليفه وهو علم المنطق وعلم الطبيعي

وعلم الكلام

ROMAE,
In Typographia Medicea.
M.D.XCIII.
Cum licentia Superiorum.

The "prince of physicians" is seated in the professor's chair in this engraving from a Latin edition of the *Canon* dating from 1520-1522.

Five heirs of Avicenna

Avicenna occupies a central position in the history of European thought. It was through his interpretations and commentaries that the doctrines of the great thinkers of Greco-Latin Antiquity such as Aristotle, Plato, and Plotinus reached the thinkers of the medieval West. On this double page we show portraits of five of the medieval "heirs" of the great Islamic philosopher: 1) the Englishman Roger Bacon (1214-1294), known to posterity as the *doctor admirabilis,* is depicted in this 19th-century engraving ; 2) his contemporary, the Scottish theologian John Duns Scotus, one of the founders of scholasticism; 4) the German Albertus Magnus (13th century) in a miniature by Tommaso di Modena, and his great pupil, the Italian theologian St. Thomas Aquinas (5) as shown in a 15th-century painting by Benozzo Gozzoli; 6) the English poet Geoffrey Chaucer (c. 1340-1400). Avicenna is mentioned as essential reading for a physician in Chaucer's *Canterbury Tales.* 3) Imaginary portrait by Goya of the Christian Father St. Augustine of Hippo (354-430).
St. Augustine's idea of "interior illumination" was to inspire a current of medieval Christian thought which echoed some of the mystic doctrines of Avicenna.

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Photo © Harlingue-Viollet, Paris

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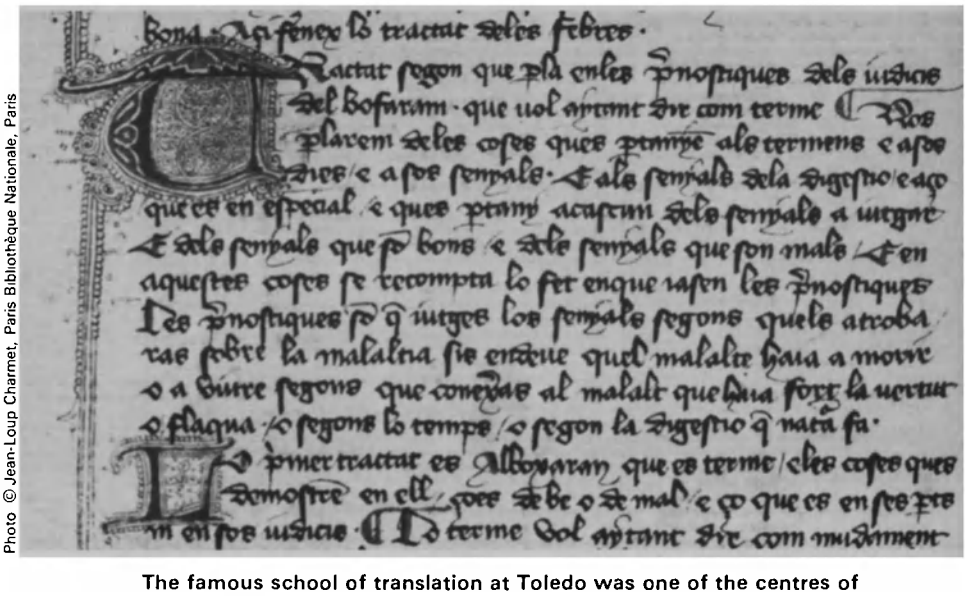

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The famous school of translation at Toledo was one of the centres of learning which brought Avicenna's work to a wider audience. At Toledo the *Canon* was translated into Latin in the 12th century by the Italian Gerard of Cremona, aided, as the Catalan scholar Joan Carreras i Martí has pointed out, by Jewish and Muslim assistants. Parts of an early translation of the *Canon* into Catalan have survived in a 14th-century manuscript now in the Bibliothèque Nationale, Paris. Above, a page of the manuscript, which consists of the section of Book Four dealing with fevers and a fragment of Book one.

Photo Pierre Berger © Rapho, Paris

Left, the University of Brussels, where a course on Avicenna was offered as late as 1909.

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In Avicenna's time astronomy was related to astrology, a subject for which the Arab philosophers generally speaking showed little sympathy, and even less for the alchemical elements derived from it. Nevertheless, the introduction of Arabic alchemy into the Latin world is an established historical fact, and Avicenna played a crucial role by imposing a more balanced attitude among European thinkers faced with the more fantastic and purportedly mystical tendencies of other, less objective and less responsible authors. He helped the West to preserve a critical approach to the impostures of alchemy. The second work on alchemy to be translated from Arabic to Latin was the relevant chapter of Avicenna's *Kitab*, in the version produced by Alfred of Sareshel around the middle of the twelfth century.

In the Latin version of his authentic treatise on alchemy and mineralogy, which was often mistaken for the appendix to the Fourth Book of Aristotle, he expounds a theory which the more thoughtful Latin authors would later take up. In this work, Avicenna condemns alchemy, especially where it concerns the transmutation of minerals, thus flying in the face of the most widely accepted notions of his time. He admits only that skilled artisans working with special tinctures can obtain from other metals imitation gold and silver. But, in Avicenna's view, the real transformation is impossible and cannot be defended either scientifically or philosophically. Avicenna's views were cited in nearly all the treatises of the thirteenth century, and later, in the Latin world. The encyclopaedist Vincent de Beauvais (d. 1264), while admitting the possibility of transmutation, was sufficiently influenced by Avicenna to express certain reservations.

It is, on the other hand, generally forgotten that Avicenna was one of the main sources of geological knowledge for the Latin Middle Ages, the principal work of reference being the *Kitab al-Shifa* in the translation of Alfred of Sareshel. The general principles of geology as understood by the great encyclopaedists of the thirteenth century, notably Vincent de Beauvais and Albertus Magnus, are drawn principally from Avicenna. When they explain the motions of the sea, erosion, and the origins of mountains, they are simply repeating Avicenna's doctrines. Avicenna was probably the Christian world's richest source in herbalism and botany, as well.

Turning to zoology, wa are confronted with this surprising statement by Sarton: "The real fountainhead of Aristotelian zoology, East and West, from the eleventh

century on was the Arabic summary of the nineteen books by Ibn Sina. In a sense we might even say that Ibn Sina was indirectly the main fountainhead of medieval zoology...".

To conclude this discussion of the sciences, it should be pointed out that in its Latin translation Avicenna's encyclopaedia made many of the notions of Arab physics familiar in the West. Avicenna was one of those who transmitted to medieval physics the Arabs' far-reaching studies of motion, contact, force, vacuums, the infinite, light, heat, the finite speed of light, and their investigations of the specific gravity of bodies. The theory of gravity and the tables of densities of both liquids and solids entered Europe by way of the Arab world. Avicenna's *Canon* was, for example, the main source used by the Florentine physician Dino del Garbo (d. 1327) for his work *On Weights and Measures*, while Avicenna was one of the new authorities cited by Peter of Albano or Padua when he completed his *Liber compilationis de Physiognomia* during his stay in Paris in 1295. Avicenna, like Averroës, also influenced the medieval theory of colours.

But it is medicine that constitutes perhaps the most brilliant chapter of Avicenna's life, and one that made him until relatively recently one of the great masters of Western thought. His undisputed sway in this discipline was based on two works, the *Canon* and the *Aryuza*, a diadactic poem on medicine (see article page 13). Still read today, the *Canon* was for seven centuries regarded in the West as an authoritative manual for instruction in and the practice of medicine. Between 1150 and 1187 it was translated in its entirety by Gerard of Cremona. It was subsequently translated no less than eighty-seven times, mostly into Latin but often into Hebrew. All of these translations were done in Spain, Italy (above all Sicily), and the South of France.

It would be safe to say that Avicenna held undisputed authority as long as medicine was predominantly theoretical, and that his influence waned with the coming of experimental science.

The *Canon* gradually became the basis of medical instruction in all universities. It was part of the oldest recorded medical curriculum at the Faculty of Medicine in Montpellier, as established in a Bull of Clement V dated 1309, and remained a part of the Montpellier curriculum until 1557. True enough, ten years later, preference shifted to Galen, but Avicenna continued to be taught there until the seventeenth century. The fact that an Arabic edition of his work was brought out in Rome in 1593 is some indication of the regard in which he was held.

At the outset, Arabic medicine was more theoretical than practical, and it may be that one of the shortcomings of Avicenna's influence was that his theoretical brilliance constituted an obstacle to practical research. But this does not alter the fact that in experimental surgery he served as guide to a succession of brilliant practitioners.

Thus Guglielmo Saliceti (c. 1210-1277), physician and surgeon of Piacenza, wrote a general treatise on medicine whose title, *Summa conservationis et curationis,* is reminiscent of Avicenna's great encyclopaedic work. Avicenna is among the authors most frequently cited by him.

Medieval treatises on medicine often contained an introduction to anatomy. All of them referred to and plagiarized the *Canon* which was considered as the supreme medical authority of the Christian world, just as it was in the world of Islam.

In prophylaxis and pharmacology as well, Avicenna was the Europeans' undisputed master. Cardo of Milan, who practised in the second half of the fourteenth century, wrote a work entitled *A Regimen for the Plague*, in which he summed up the prophylactic techniques then in use. One of his principal sources was Avicenna. At about the same time, Franchischino de Collignano, a Florentine physician, wrote a treatise on the plague in which he used Galen and Avicenna as his main authorities. Another treatise, *De Venenis,* is largely derived from Avicenna.

Traces of Avicenna's influence can also be found in medieval European ophthalmology. In an anonymous treatise on this subject written in the second half of the thirteenth century, Avicenna is the most frequently quoted author, and almost all the ophthalmological works of fourteenth-century Europe rely heavily on Arab sources, and mainly on Avicenna.

In obstetrics and gynaecology too Avicenna stands out as one of the great masters of the Middle Ages. The highest praise that could be bestowed on a doctor in medieval times was to call him "another Avicenna". In accordance with this practice, the Italian physician Gentile da Foligno was styled "the soul of Avicenna". Consulted by Cino da Pistoia about the case of a seven-month child, he wrote a treatise citing a number of authoritative sources including Aristotle, who had cited an instance of an eleven-month baby, and Avicenna, who had discussed that of a fourteen-month child. Da Foligno also wrote a commentary on the chapter of Avicenna's *Canon* relating to fevers.

Avicenna's influence on Spanish authors of this era and on earlier medieval writers also extended to semiology or diagnosis through external symptoms such as observation of the pulse. Sarton believes that Avicenna can be considered the founder of semiology.

Finally, psychotherapy and parapsychology were another field in which Avicenna was ahead of his time. When medieval writers theorized about psychological methods of healing they illustrated their works with the most spectacular cures which he achieved. The Frenchman Nicole Oresme (c. 1323-1382), one of the fourteenth century's greatest scientists, went along with Avicenna in believing in thought transference, but rejected his suggestion that human thought is capable of moving objects without physical contact.

But there inevitably came a moment when Avicenna's influence as the great authority in medicine went into decline. A reaction against him set in during the Renaissance, with the development of a tendency to go directly to the Greek sources instead of using Arabic intermediaries. Leonardo da Vinci rejected Avicenna's notions of anatomy (although the lack of an adequate vocabulary forced him to continue using Arabic terminology). The physician and alchemist Paracelsus (c. 1490-1541) burned the *Canon* in Basle in a public display of repudiation. The Englishman William Harvey dealt Avicenna's work a severe blow with the publication in 1628 of what he considered to be his great discovery, the circulation of the blood, which was unknown to Avicenna.

What Harvey did not know was that this discovery had been made four centuries before, even preceding the Spanish theologian Michael Servetus (1511?-1553), by the Arab Ibn al-Naphis (1210-1288), who used Harvey's own argument concerning the thickness of the wall separating the ventricles of the heart, in a critical commentary on Avicenna's theory.

Little by little, philosophic and theoretical medicine made way for the practical and experimental medicine of modern times. Even so, the University of Brussels continued to offer a course on Avicenna's medicine until 1909.

Today it is possible to study medicine without recourse to Avicenna's Arabic texts. It is impossible, on the other hand, to ignore the immense role of human thought, Eastern as well as Western, over the centuries, and to forget the great debt that European culture owes to Avicenna in philosophy, mysticism, the natural sciences and medicine.

■ **Salvador Gómez Nogales**

A forerunner of modern science

by Abid S. Sadykov

BEYOND all question, Avicenna (Ibn Sina), whose million-word encyclopaedia the *Canon of Medicine* remained the supreme medical reference book for six centuries, can be considered the greatest physician of all peoples, places and times. Furthermore, his philosophical encyclopaedia, the *Book of Healing*, and his *Book of Knowledge*, a work written in Persian, place him among the world's foremost thinkers. Indeed, so great is his renown as a philosopher and a physician that it has tended to overshadow his contribution to the development of the natural sciences.

Yet Avicenna worked intensively on physics, astronomy, mathematics and mineralogy, and put forward a number of productive ideas of great overall impact on the natural sciences of his times, and which remain topical even today. One such problem, for instance, was that of movement and the measurement of movement. In this highly important branch of physics, he based his analysis on two concepts: the rapidity and slowness of movement. He viewed them quantitatively and qualitatively: "The quantity between the start of that which went before and the end of that which follows is the measure of the rapidity or slowness of movement".

"That which passes in a short time moves quickly", he observed, and advanced the theory that speed depends on what in modern physics is termed "mass": "That which is smaller should move more quickly, and that which is larger more slowly; but in reality, we see the reverse".

Avicenna distinguished between the speed of light and of sound. "Thunder can be seen and heard", he wrote. "Thunder (lightning) is seen at one time, but heard at another, after it (the sound) has moved in the air and gradually reached the hearing". In other words, he established the difference in the speeds of the two forms of movement of matter.

Avicenna was the first to formulate such concepts as the "quantity of movement", "motive force" and "impulse", which were propounded in the mechanics of Western Europe in the seventeenth and eighteenth centuries. He heads the long list of scientists—Descartes, Huyghens, Leibnitz, D'Alembert, Thomson, Kirchhoff and others—who worked on the problem of the measurement of movement, although no-one prior to Descartes, and subsequently Leibnitz, treated it on a genuinely scientific basis. Be that as it may, Avicenna's contribution should be noted in the recorded history of physics.

To modern science, Avicenna's investigation of the problem of the unity of space and time is far from irrelevant. "Movement has two quantities beside itself: one is the length of its path..., the other quantity... is called time". In other words, Avicenna sees space and time as the quantities of movement.

Following Aristotle and a few later thinkers, he denied the existence of a void, advancing the theory that neither movement nor repose can exist in a void. He adduced that "in a void there can be neither natural nor forced movement or repose. Any body which is in a place either moves or is in a state of repose. Thus by this argument and by other proofs, it is established that bodies do not exist in a void".

Such ideas on the part of Avicenna to some extent laid the foundation for the law of inertia: the body is "in its place", i.e. not influenced by an external force. His refutation of the void— and the support it has lent this fertile scientific tradition—prepared the ground for the future recognition of many fields of physics, including gravity and electromagnetics.

He made interesting conjectures about the transmission of energy and light. "Bodies act upon each other in two manners," he asserted, and defined those manners as: "by contact as when ice touches something, it cools it, or when wind contacts something, it moves it; in another manner, as when green grass leaves a green light on an adjacent wall, or when human faces leave an imprint in the observer's eyes or in the mirror".

Extrapolating his views to the field of "cosmic" phenomena, he asserted—as had previously Aristotle and his disciples—that many empirically observed phenomena are connected with, for instance, the influence of the Moon. He wrote: "The light and forces emanating from the Sun and other luminaries influence our world. Among the most obvious influences of the heaven and the Moon is that the Moon... causes the sea tides to flow".

In correspondence with al-Biruni, Avicenna advanced his own version of the principle of the conservation of movement, postulating that both presently and potentially, a sphere was neither light nor heavy.

CONTINUED PAGE 44

Left, this fearsome panther head embellishes a bronze perfume phial dating from the 11th century. Found at Khulbuk in Tadzhikistan, the phial is 22.4 centimetres in height. On one side is inscribed the name of the maker, Ali Ibn Abu Nasr, and on the other an Arab Ibn Abu Nasr, and on the other an Arab maxim: "The occasion brings forth the man".

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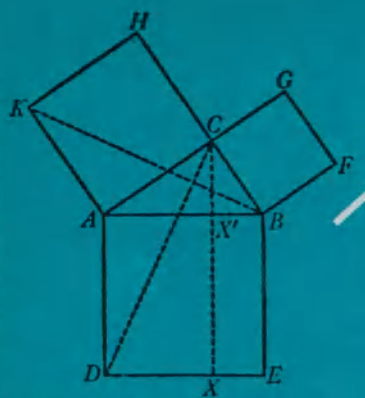

HELLENISTIC

HELLENIC

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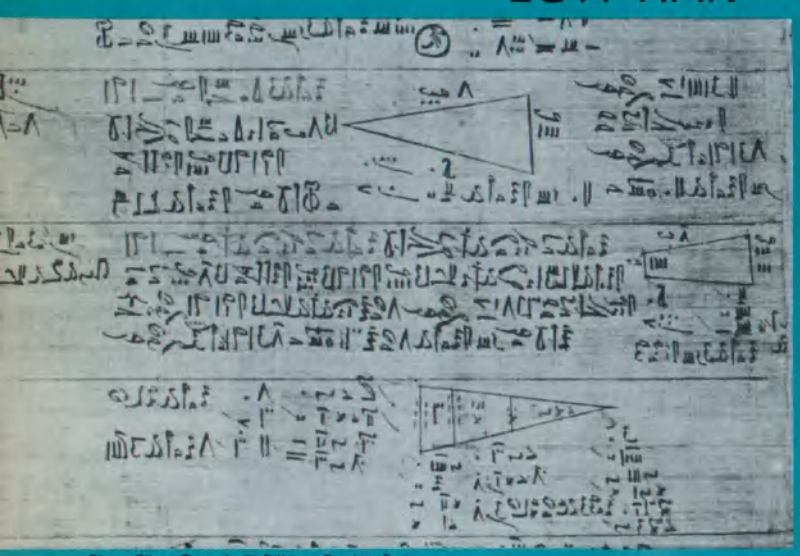
SABAEAN

Photo Goursat © Rapho, Paris

EGYPTIAN



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BABYLONIAN

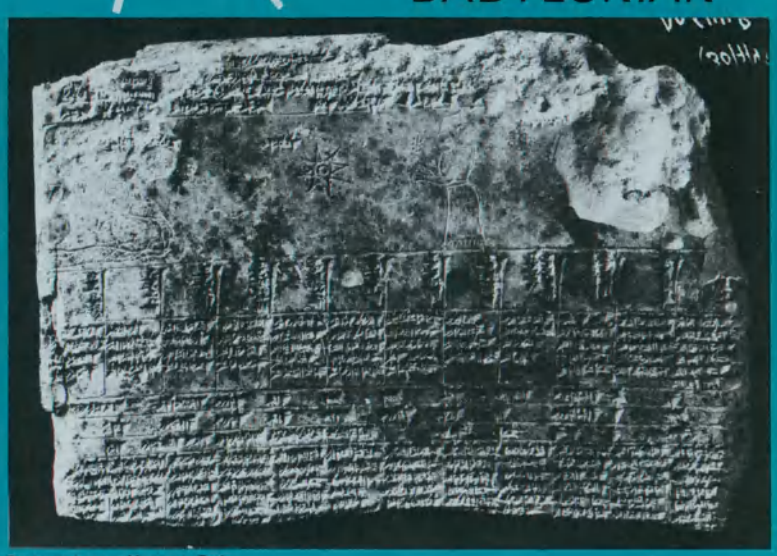


Photo © Louvre Museum, Paris

ISLAM — CRADLE OF

The findings in mathematics, astronomy and medicine of the two great river civilizations of Egypt and Babylon were developed and given a theoretical framework by such thinkers as Pythagoras, Plato and Aristotle in the golden age of classical Greece. However, it was from Alexandria, the centre of the later flowering of the Hellenistic period, personified by such figures as Euclid and Ptolemy, rather than from Athens that the heritage of the past was to reach Islam. The transmission of this Greco-Hellenistic tradition was not direct but passed through the Sabaeans of Haran and the Sassanids of Persia. It was via the Sassanids and the centres they established, such as the medical institute of Jundishapur, that Persian and Indian sciences mingled with the Greek heritage to reach the Islamic world. The contribution of the Far East to Islamic science does not compare in any way with that of Greece, India, Persia and Egypt, but the importance of such Chinese technological innovations as paper-making should not be under-estimated.

Above, schematic representation of the transmission of scientific thought. EGYPTIAN. Fragment of the Rhind papyrus, the original of which dates back to 1800 BC, is one of the main sources of our knowledge of ancient Egyptian mathematics. BABYLONIAN. Astrological tablet from Uruk in Lower Mesopotamia dates back to

Photo © Bibliothèque Nationale, Paris

"Islamic science came into being from a wedding between the spirit that issued from the Koranic revelation and the existing sciences of various civilizations which Islam inherited and which it transmuted through its spiritual power into a new substance, at once different from and continuous with what had existed before it. The international and cosmopolitan nature of Islamic civilization, derived from the universal character of the Islamic revelation and reflected in the geographical spread of the Islamic world, enabled it to create the first science of a truly international nature in human history.

"Islam became heir to the intellectual heritage of all the major civilizations before it save that of the Far East, and it became a haven within which various intellectual traditions found a new lease upon life, albeit transformed within a new spiritual universe. This point must be repeated, particularly since so many people in the West wrongly believe that Islam acted simply as a bridge over which ideas of Antiquity passed to medieval Europe. As a matter of fact nothing could be further from the truth, for no idea, theory or doctrine entered the citadel of Islamic thought unless it first became Muslimized and integrated into the total world view of Islam."

Seyyed Hossein Nasr
From *Islamic Science, An Illustrated Study*

ISLAMIC

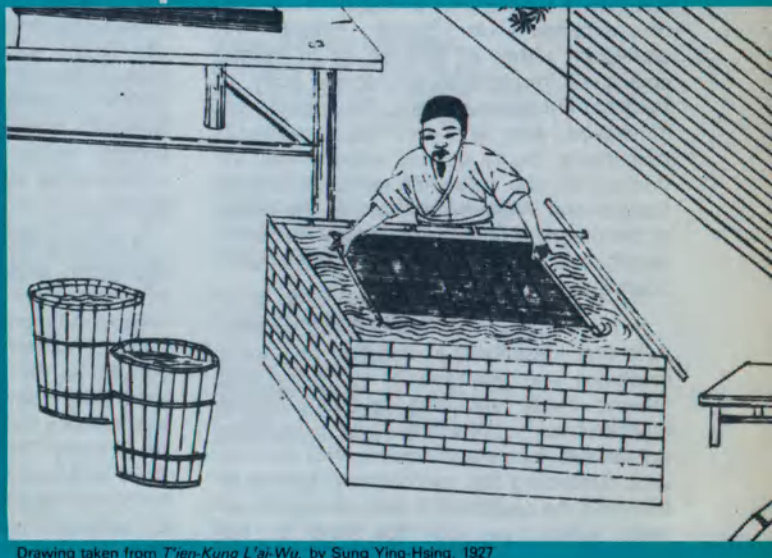
Photo © Giraudon, Paris

PERSIAN

INDIAN

CHINESE

Photo Serge Koutchmy © CNRS, Paris



Drawing taken from *T'ien-Kung L'ai-Wu*, by Sung Ying-Hsing, 1927

INTERNATIONAL SCIENCE

the second century BC. INDIAN. Recent photo of an eclipse of the sun. Indian astronomers are thought to have taught Muslim scholars various methods of determining eclipses. CHINESE. Arab tradition has it that a Chinese prisoner captured at the battle of Talas (751 AD) revealed to the Arab world the secrets of paper-making. HELLENIC. Pythagoras (580-500 BC), mathematician and philosopher who deeply influenced classical Greek thought. HELLENISTIC. Euclid's proof of the Pythagorean theory. Euclid founded and taught at a school in Alexandria during the reign of Ptolemy I Soter (323-283 BC). PERSIAN. The goddess Anahita as depicted on a Sassanid bowl. Under the Sassanids Persia transmitted to Islam Greek and Indian learning as well as its own scientific tradition as exemplified by the Royal Astronomical Tables. SABAEAN. The Sabaeans of Haran passed on to Islam many aspects of Babylonian astronomy and mathematics that are not reflected in Greek texts. ISLAMIC. The golden age of Islamic science. Illustration of a scholar giving a lecture from a 13th-century manuscript of the Maqamat, a collection of tales written by al-Hariri (1054-1122 AD).

CONTINUED FROM PAGE 41

"The proof is," he wrote, "that either the potentially light and potentially heavy are such in their whole, as is seen in the case of the particles of elements, which remain motionless in their natural places... or (they) are such in their parts and not in their whole, as we may see in combinations of elements, which are neither light nor heavy since, if some combinations of the elements move upwards, then the other half of them must move downwards". This theory may be said to approximate to a grasp of the principle of the conservation of movement, which was further developed by Galileo, and subsequently, by Descartes and Newton.

Avicenna's thinking on anthropogeny, which encapsulates the most advanced ideas of his time, is of unquestionable interest. For instance, he put forward the theory that man's origins lie in an animal species. He wrote that until a species "has acquired all the senses that are capable of apprehending the things perceptible to the senses, neither can nature, of necessity, transform it from an animal to a rational species". Of course, this theory is still well behind that of Darwin, but it may nonetheless be viewed as a kind of hypothesis which no one prior to Darwin was able to turn into a genuinely scientific theory.

Avicenna's creative approach to some problems of physics and mechanics is shown in the *Kitab al-Shifa* (Book of Healing) and the *Danish-Nameh* (Book of Knowledge), and also in separate treatises and in correspondence with al-Biruni. Defending the theory of the "motive force" put forward by the sixth century Alexandrian philosopher John Philoponus, and considering the problem of the relationship between "forced" and "natural" movement, Avicenna propounded his own theory of the mechanics of movement. The gist of it is that "a kind of incorporeal kinetic force" or dimension—to some extent the equivalent either of impulse or of kinetic energy—is imparted to the moving body. In Western European science, this incorporeal dimension was later termed "impetus". Avicenna's theory exerted considerable influence on the views of many scientists, Eastern and Western, and lies at the origin of the theory of impetus finalized in the fourteenth century by the French philosopher Jean Buridan.

In his treatise *The Measure of Wisdom*, Avicenna described a number of simple machines and mechanisms for lifting and moving loads, and also several complex mechanisms consisting of pulleys, windlasses, levers and screws. Not content with describing the mechanisms known in his times, he suggested a few new combinations which we do not find in his predecessors' works, even in those of the ancient Greek scholar Heron of Alexandria, who illustrated the main achievements of antiquity in applied mechanics. The principles Avicenna described were the basis of various devices used throughout Central Asia for raising water or processing oil, grains or cotton.

Neither can his contribution to the development of geometry and pure mathematics be overlooked. In his commentary on Euclid's *Elements*, for instance, he attempted to improve the structure of the latter's axioms in order to provide a theoretical foundation for geometry. In arithmetic, he introduced the Indian method of testing the simplest functions by using the number 9, and generalized its use for finding the cubes of numbers. In this field as in many others he helped to promote the development of abstract thought in the Islamic countries.

Avicenna also wrote works on astronomy. His *Message* to Zarrin Gis, daughter of Qabus Ibn Washmgir, the ruler of Gorgan, is lost to us, but al-Biruni was acquainted with the *Message* and analysed it in his *Geodesy*. To us, the value of this work is that it contained Avicenna's radically new method of determining the difference in the geographical longitudes of two localities. Its gist is as follows: the culmination of the moon is observed at the meridian of a locality of which the longitude is unknown. Then the position of the moon is calculated using tables compiled for a locality whose longitude is known. The difference between the calculated and observed positions of the moon is translated into the difference in local times at the two localities, and that will be the difference in their geographical longitudes. Avicenna formulated this method in Gorgan between the years 1012 and 1014. Exactly five hundred years later, in 1514, the method was rediscovered in Europe by the astronomer Johannes Werner (1468-1528).

In Isfahan, where his fates took him, Avicenna built an observatory and, using instruments he himself invented, made continuous observations of the luminaries over a period of several years. The result was his ephemerides, or tables showing the daily positions of the planets in relation to the ecliptic. His calculations have proved more accurate than those of the ancients. He was among the first medieval astronomers to prove that the sun's apogee is not fixed. He invented a special instrument combining several large rulers set in elevation, which he used to determine the altitude and azimuth of the luminary. To refine his measurements, he used an original method which subsequently became known as Nonius' method, after the Portuguese scholar Pedro Nunhes, or Nonius, who rediscovered this method in the sixteenth century.

Avicenna had no special knowledge of chemistry, although he undoubtedly knew of some chemical reactions from mixing compound medicines, for instance, where in some cases the number of components was as high as thirty or forty. However, he undoubtedly sponsored the development of that science by his uncompromising critique of alchemy. Here is what he wrote in the *Book of Healing* on that score: "Alchemy is far behind nature, and cannot catch up with it, although it endeavours to do so. As regards the pretensions of alchemists, then they can produce no genuine change of species. They can perform good imitations, painting red metal white so that it resembles silver, or yellow so that it resembles gold...But the substance of those metals remains unchanged thereby..."

In his pursuit of science, Avicenna attached enormous importance to water—omnific, dissolvent, uniting and destructive. In some cases, he saw the solution of substances in water as transformation. He gave special preference to mineral waters, because of the metals dissolved in them: if mineral waters contained salts, gold and silver, then they were beneficent to the human organism. Of all waters, he considered the best, because of its solvent qualities, to be "purified" water, which could be obtained from ordinary water, and he proposed a very original technique for obtaining a kind of distilled water: a layer of wadding is placed over a cauldron of boiling water, and from time to time it is removed and wrung out...

On metals too, Avicenna's views were his own, and he placed special emphasis on mercury. From the ninth to eleventh centuries, this metal was extensively used in Central Asia: according to available information, several hundreds of metric tons of mercury were then extracted there.

At the same time, the mining of other metals was quite advanced. Like his predecessors and contemporaries, Avicenna viewed gold, for example, as the most perfect of substances, the sovereign mineral. He also recommended the salts of some heavy metals for external use. The techniques for making sublimates of mercury were known to Avicenna's contemporaries. The physical and chemical properties of sublimate were also known, and it was recommended for treatment of external complaints. Gold and silver were deemed excellent medicaments for strengthening the heart and cleansing the blood. In addition, he described the use of finely-ground glass, salts, antimony, iron, lead and blue vitriol for treating diseases of the eye and some other organs.

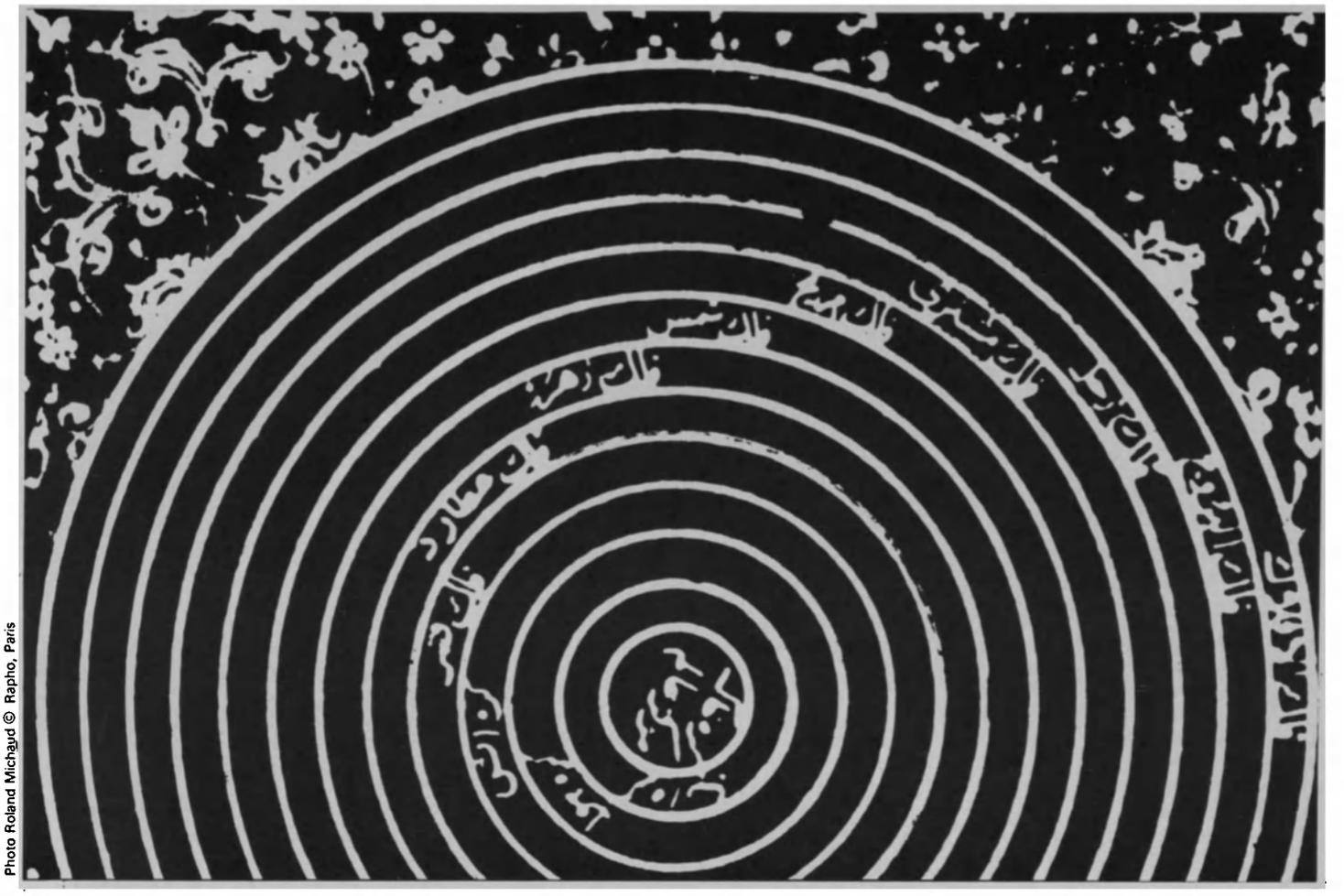
Avicenna postulated that various substances interact together, forming a mixture in which one of the components predominates. A simple substance, he thought, could not produce other substances. In these views, an embryo of inorganic chemistry is not hard to detect.

Where Avicenna's contribution to mineralogy and geology is concerned, pride of place must go to the classification of minerals he proposed, with its very rational division into four groups: stones, ores, fuels and salts. That division was taken over in its entirety by European mineralogy as of the late Middle Ages; it was maintained in the Renaissance, and virtually until the nineteenth century. Even the first classification of minerals by chemical composition, which was proposed by Torbern Olaf Bergman of Sweden in 1780, sub-divided all minerals into *Sales* (salts), *Terrae* (earth and stones), *Bitumine* (hydrocarbons) and *Metalla* (metals): an exact repetition of Avicenna's system. To commemorate his services to mineralogy, one of the thallic minerals discovered in the Uzbek SSR has been named avicennite.

Finally, it may be mentioned that Avicenna thought the erosive effects of wind and water to be one of the factors in the formation of valleys and ravines. Considering the fossilized sea creatures known at the time, he said that the lands where they had been found had formerly been sea-beds. He explained correctly that earthquakes were due to deep-seated geological processes.

"If I see somewhat further than Descartes, that is because I am standing on his shoulders", declared Newton. And if modern science has advanced so far since Avicenna's day, then that is only because it has "stood on the shoulders" of many pioneers, including, of course, those of Avicenna himself.

■ **Abid S. Sadykov**



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The secret of the stars

by Ahmed Süheyl Unver

IN the 11th century a Turkish ruler who was known only by the name of Giyaseddin, wondered why stars are visible at night and not during the day. Some of the learned men of the time offered him the explanation that during the daytime the more intense sunlight overshadowed the light cast by the stars, whereas at night, after the setting of the sun, stars once more became visible. This answer was then compared by the ruler with another explanation given by a smaller group of learned men. According to their answer to Giyaseddin's inquiry, the intensity of starlight is diminished during the daytime; because of this, light cannot penetrate into the depths of heaven.

Giyaseddin, the ruler, who viewed these answers critically, asked of Avicenna: "How can sunlight vanish from the semi-spherical heaven? That sunlight can be completely screened from heaven at any time of the day is not possible since it is known that the world which comes in between the sun and the semi-spherical heaven is not so large as the sun itself. The world can prevent the sun's rays from falling on a part of heaven that is equal only to its own size. But since the sun is many times larger than the world, the part of heaven that is screened from the sun's rays at any time will be very small in relation to the world and even much smaller in relation to the sun."

Avicenna, too, was not convinced of the validity of the explanation offered by his colleagues. Indeed, no one ventured further in solving this important problem than the explanations cited above.

Avicenna offered the following explanation: it is true that at night the sun's rays are transmitted to this end of Space. Space, like air is transparent. Transparent substances possess two important properties: one is that they are not luminous but transmit light; they are not brightened themselves. The second property is that they do not obstruct the path of vision. During the day the sun which is above the horizon brightens the foreign components in air, such as dust and vapour. These components, which of themselves are not transparent appear bright on account of light rays falling on them from other sources. Thus during the daytime our surroundings appear bright and the stars become invisible. This is easily proved when at night the visibility of stars in the light of a flame becomes diminished.

By this explanation, it becomes evident that Avicenna has satisfactorily attributed the solution of the present problem to the effect of the diffusion of light. ■

AHMED SUHEIL UNVER, *of Turkey, is a member of the Turkish Historical Institute and a former professor at the Faculty of Medicine and the Academy of Fine Arts at Istanbul. The founder of the Istanbul Institute of Medicine, he has published a number of studies on Avicenna as well as works on Turkish miniatures, calligraphy and painting.*

O Vault of Heaven, O Firmament,
In the name of the Creator, tell me,
Do you spin above us by your own design?
Or are you by another's power constrained
To eternal movement?

For mortal man you are Infinity;
Perplexed we wonder within what frame
Your revolutions are set. Can it be
That for you a greater Infinite exists?

Are you the haven to which souls return?
Or do they perish with our mertal coil?

The Sun that you up-hold
Shoots out its rays
As though from the feathers
Of a great bird's wing.

But the Milky Way!
Is it a billow in the ocean of the sky?
Or is it the image of a sword
Reflected in a burnished breastplate?

The crescent Moon? Is it a pendant
On the necklace of the Stars
Shining through the night obscure?
Or is it a bracelet on an unknown hand?

The Stars? Are they encrusted pearls?
Or foaming bubbles crowning mighty waves
Whose weaving patterns by the night revealed
Like some great sail, when daylight comes,
Are folded carefully away?

(Extract from a poem by Avicenna)

UNESCO NEWSROOM

Soviet Union Presents Painting to Unesco

The USSR has donated to Unesco a vast modern painting (above) on the theme of "The Contribution of the Peoples of the USSR to World Culture and Civilization". The painting, by Ilya Glazunov (born 1930), depicts some of the outstanding personalities from the different peoples, nationalities and ethnic groups of the Soviet Union who have made major contributions to the progress of world civilization. The figures, set against a background of important cultural and natural sites and monuments, include Pushkin, Dostoevsky, Tolstoy, Tchaikovsky, Chaliapin as Boris Godunov, Gorki, and Yuri Gagarin. The panoramic work is now on permanent display at Unesco's Paris headquarters.

Chinese Edition of *Unesco Courier*

We are happy to announce to our readers the launching of a Chinese language edition of the *Unesco Courier*. The Chinese edition, the first issue of which appeared in July 1980, is published in Pekin by the "China Translation and Publishing Corporation". Its Managing Editor is Mme Shen Guofen. This brings the total number of language editions of the *Unesco Courier* to twenty-five, not counting the quarterly selection in Braille which is published in English, French and Spanish.

Amadou-Mahtar M'Bow Re-elected

Mr. Amadou-Mahtar M'Bow, of Senegal, has been re-elected Director-General of Unesco by the Organization's General Conference being held in Belgrade from 23 September to 28 October. Mr. M'Bow, who was elected Director-General in 1974, was unanimously re-elected by the General Conference and will serve for a seven-year term.

An Apostle of Scientific Progress

Two years ago, Unesco's General Conference proposed that, on the thousandth anniversary of the birth of Ibn Sina (Avicenna) according to the Christian calendar, Unesco should pay tribute to this great thinker (980-1037 AD; 370-428 of the Hegira) and to the immense influence his work has had on the development of science. The anniversary has been celebrated this year at international conferences and symposia, including three in the USSR, (at Moscow, Tashkent and Dushanbe) which have focussed on Avicenna's major contributions to physics, logic, sociology and literature, as well as to the exact and natural sciences and to medicine. Speakers also drew attention to Avicenna's distinguished role in encouraging, through scientific knowledge, the efforts of the human community to build a better world in which scientific development can flourish. At the Moscow meeting, Prof. Pyotr Feodosev, Vice-President of the Soviet Academy of Sciences, made the point that Avicenna saw his work as pre-eminently the fruit of communication between peoples.

"Avicenna could only conceive of man as part of a situation, as existing within the framework of society," Prof. Feodosev said. "Outside the human community, he felt, the capacities of the individual could not achieve fulfilment, since man is a social creature. Happiness is impossible, Avicenna wrote, if a man does not forge links with others."

Mr. Amadou-Mahtar M'Bow, the Director-General of Unesco, returned to this idea in his address:

"Avicenna, perhaps more than any other thinker of the great age in which he lived, proved a fundamental truth which is also, in a sense, the reason why Unesco exists: civilizations only have a future insofar as they communicate with each other, enrich each other with their mutual contributions, and recreate together, through their diversity, the unity of our destiny."

Unesco Medal Honours Avicenna

Unesco has issued a medal to commemorate the thousandth anniversary of Avicenna's birth. On the obverse side of the medal, designed by sculptor-medallist Victor Douek, is a scene inspired by a miniature in a 17th-century Turkish manuscript, and the inscription "AVICENNAE 980-1037" "UNESCO 1980" (see photo page 4). Reproduced on the reverse side is a phrase (in Arabic and Latin) by Avicenna which means "Co-operate for the well-being of the body and the survival of the human species", as well as the autograph attributed to Avicenna which appears on our cover. The Avicenna medal forms part of the "Anniversaries of Great Men" series launched by Unesco in 1975, which now includes medals struck in honour of Michelangelo, Rubens, Aristotle and Einstein. For further information about the medals, available in gold, silver and bronze, please contact Unesco's Philatelic and Numismatic Programme.

Avicenna and his time

Further reading in English

■ **Avicenna, His Life and Works,** *by Soheil M. Afnan. Allen and Unwin Ltd., London, 1958.*

■ **Introduction to the History of Science, Vol. I, From Homer to Omar Khayyam,** *by George Sarton. Published for the Carnegie Institution of Washington by the Williams and Wilkins Company, Baltimore, 1927.*

■ **Avicenna and the Visionary Recital,** *by Henry Corbin. (Translated from the French by Willard R. Trask). Routledge and Kegan Paul Ltd., London, 1961.*

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■ **The World of Islam: Faith, People, Culture,** *edited by Bernard Lewis. Thames and Hudson, London, 1976.*

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■ **Avicenna, Scientist and Philosopher: A Millenary Symposium,** *edited by G.M. Wickens. London, 1952.*

■ **The Central Asian Art of Avicenna's Epoch,** *published by the "Irfon" publishing house, Dushanbe, Tadzhik SSR, 1980.*

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'Prince and chief of physicians'

Ibn Sina, known in the Western world as Avicenna, author of the *Canon of Medicine*, an encyclopaedic treatise which remained the supreme medical reference source for six centuries, has rightly been dubbed "the prince and chief of physicians". But more than this, he is one of the handful of universal geniuses who have taken all knowledge for their province. Philosopher, scientist and poet as well as physician, Avicenna found time to design his own surgical instruments, many of which are virtually the same as those used today. Below, four instruments made recently in Uzbekistan from descriptions and sketches drawn by Avicenna himself nearly a thousand years ago. From left to right: Surgical scissors with sharply pointed blade tips for use in eye surgery; tweezers for removing foreign bodies; a lancet; and a scalpel for removing fragments of skull bone during trepanning operations.